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EXHIBIT G

ENGINEERING PROJECT AUTHORIZATION

PROJECT NO: CS-P-15 PROJECT LEADER(S): Ying Xiang
TITLE: 7 7/8 IADC 5-1-7 CUTTING STRUCTURE OPTIMIZATION (SIX KILLER) CODE: P

OBJECTIVES

Utilize the IDEAS program and IDEAS lab facilities to design, analyze and optimize a new 7 7/8 TCI cutting structure(s) targeted to increase the rate of penetration, footage, and durability compared to the currently available IADC 5-1-7 type products (especially the Reed HP51X). Iteratively field test these new designs with the ultimate goal of establishing a 15% to 20% performance differential with our competitor's products and additionally providing functional feedback for continuing IDEAS systems development.

CUSTOMER NEEDS ADDRESSED:

- 1) Performance
- 2) Reliability

TRANSLATION:

- 1) Increased ROP
- 2) Improved life and footage
- 3) Consistent dull condition

MEASUREMENTS:

- 1) Performance Reports
- 2) Analytical/Statistical Reports
- 3) Lab Tests

BENEFITS/PAIN:

Project benefits are to: 1) establish a performance advantage over our competitors in the 7 7/8 IADC 5-1-7 product range, 2) increase marketshare/revenues in the domestic TCI market, 3) further promote the utilization of the IDEAS program and lab to improve product performance, and 4) enhance our customer's perception of Smith as a leader in technological development. Potential pain is continued lost marketshare/revenues to Reed and other competitors who dominate the market for 7 7/8 5-1-7 type products.

DESIGN INPUT ACCEPTANCE:

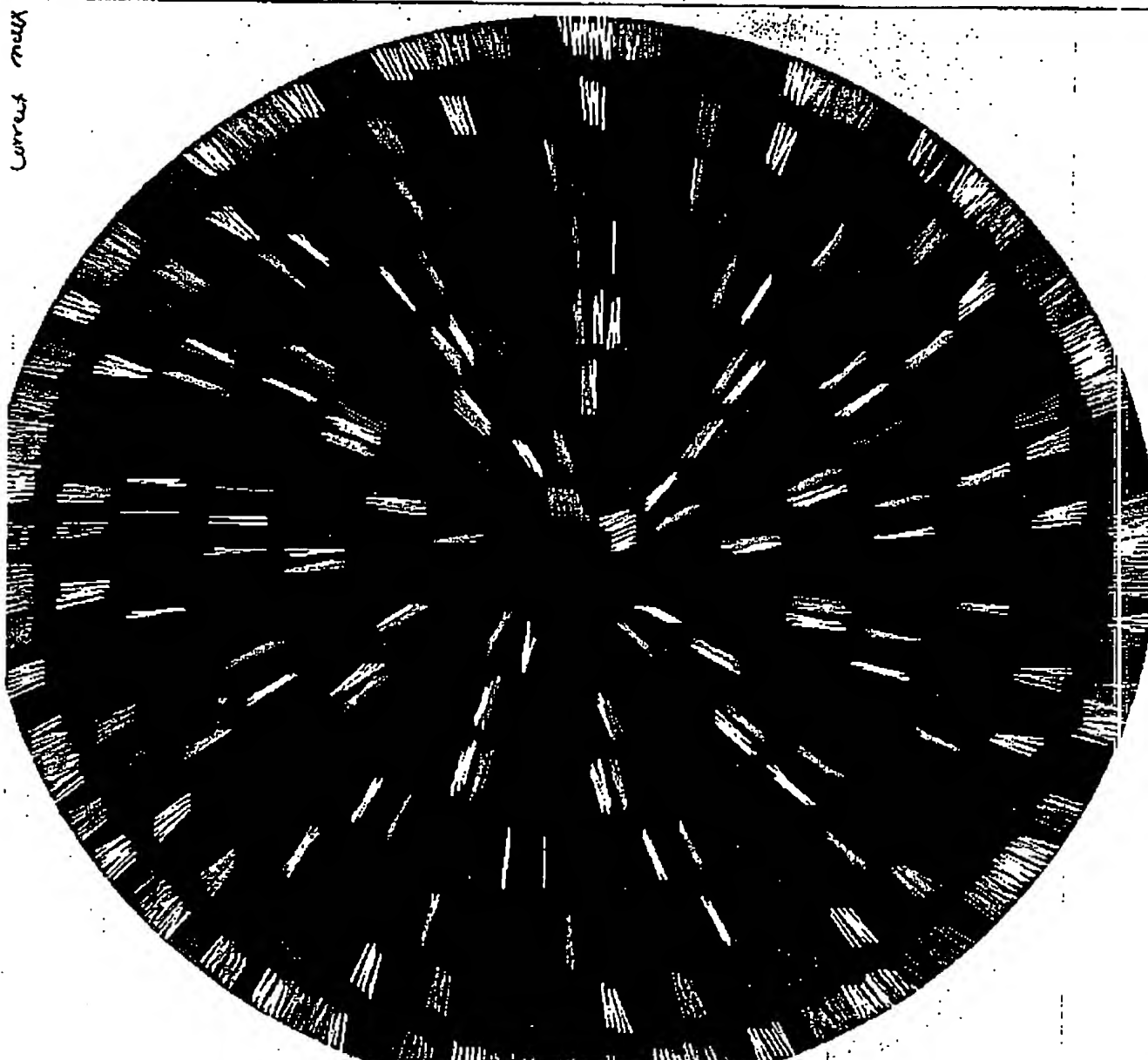
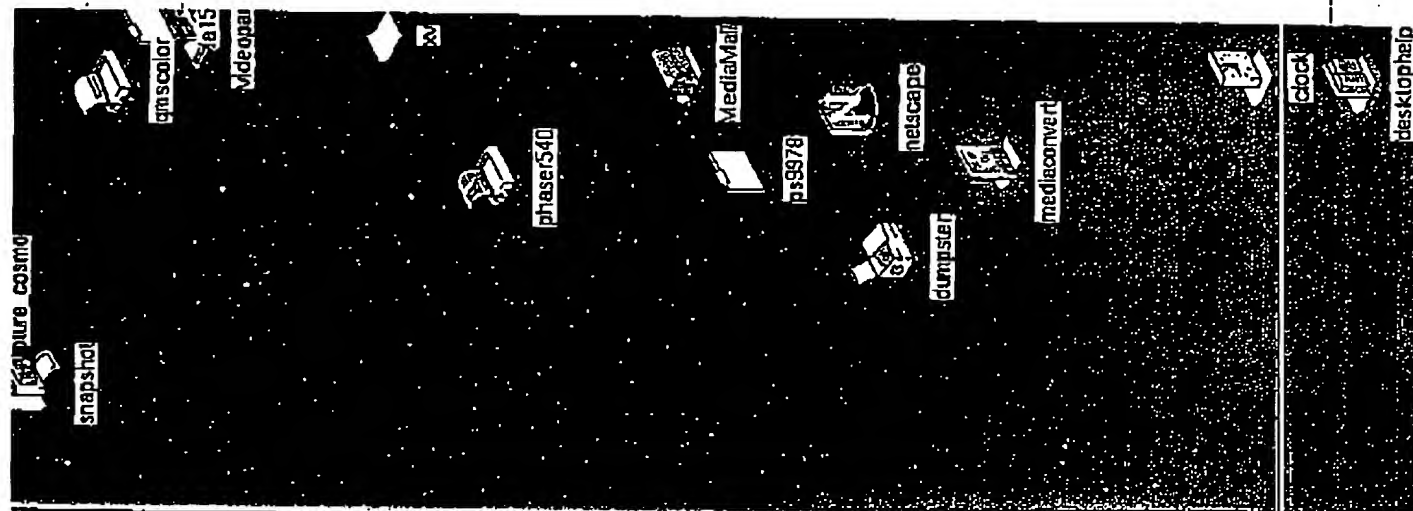
Ying Xiang 11/13/98
Project Team Leader Date

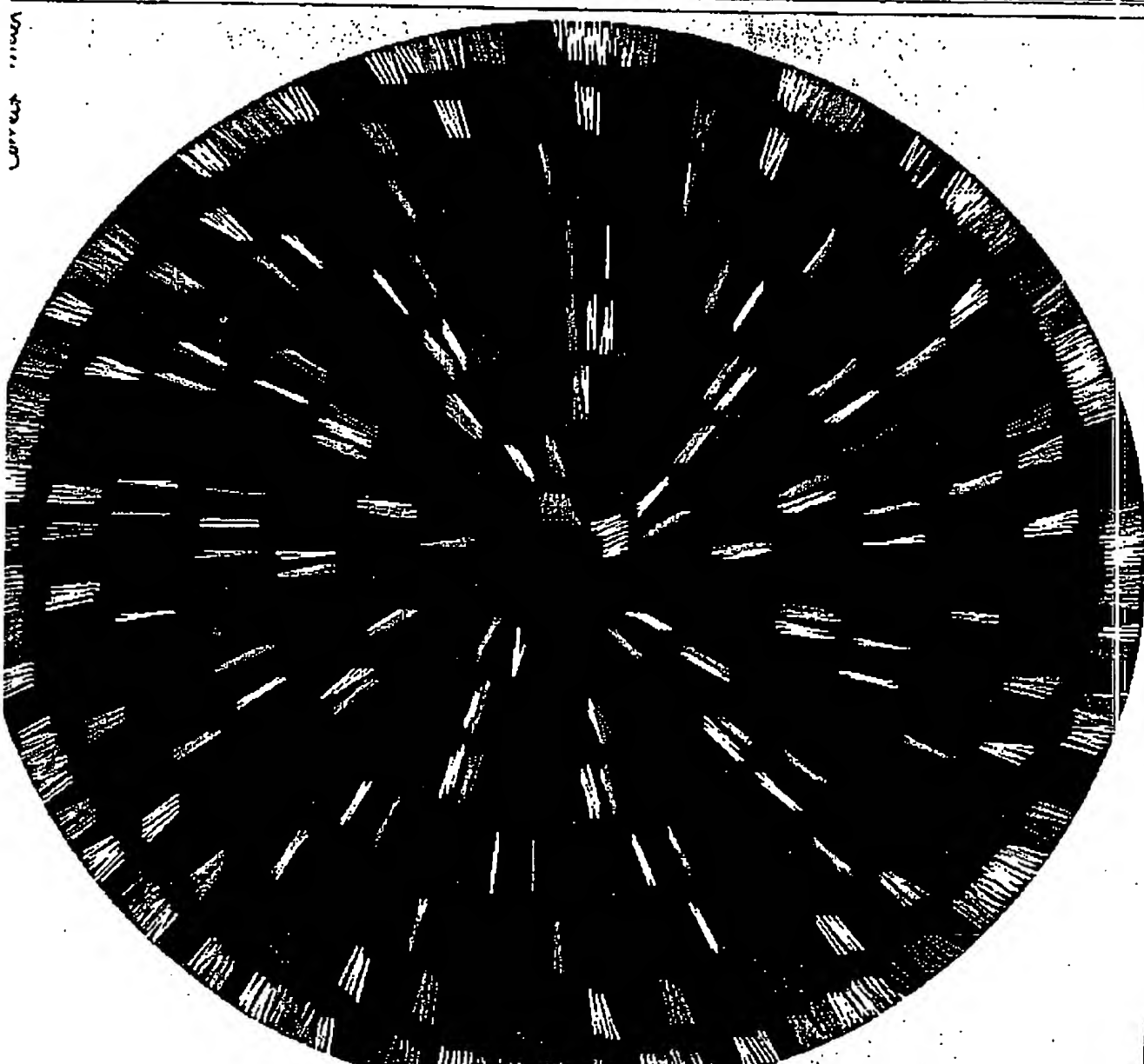
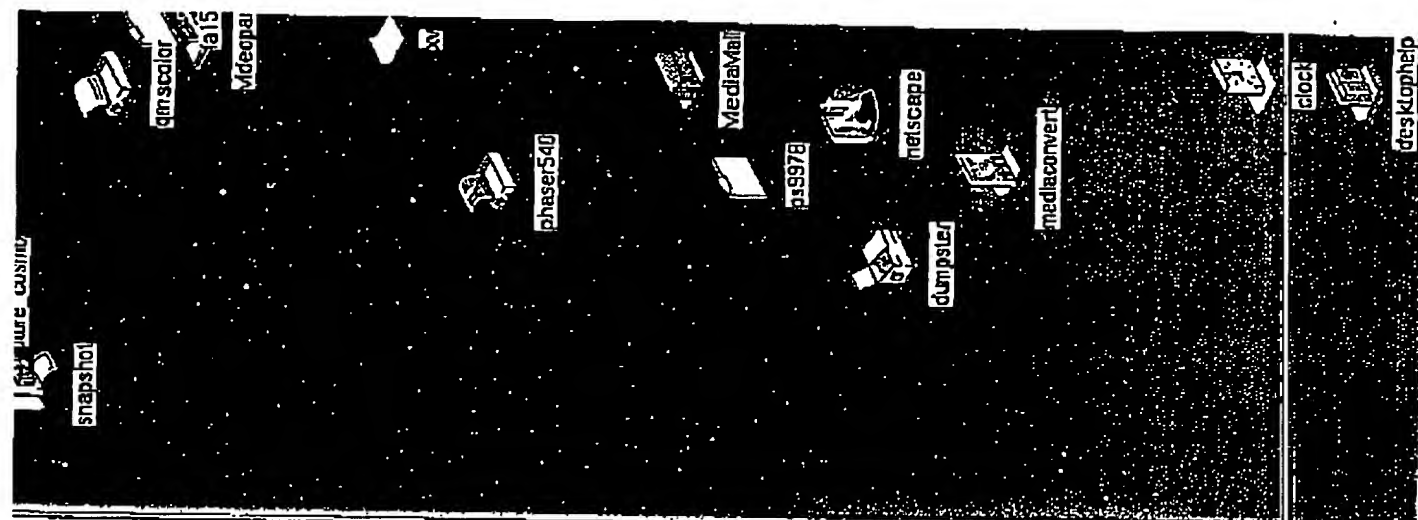
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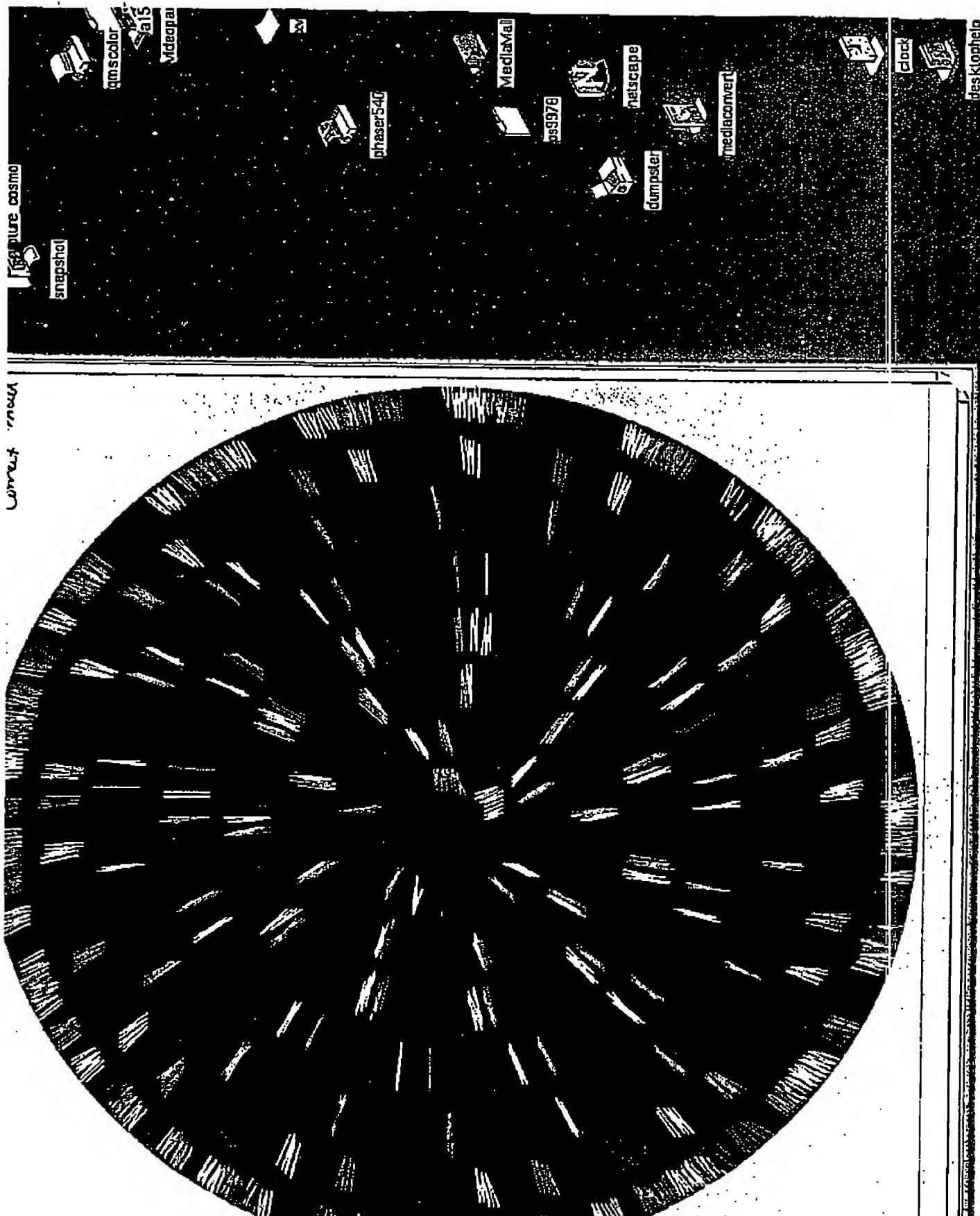
[Signature] 11/17/98
V.P. Engineering Smith Tool Date

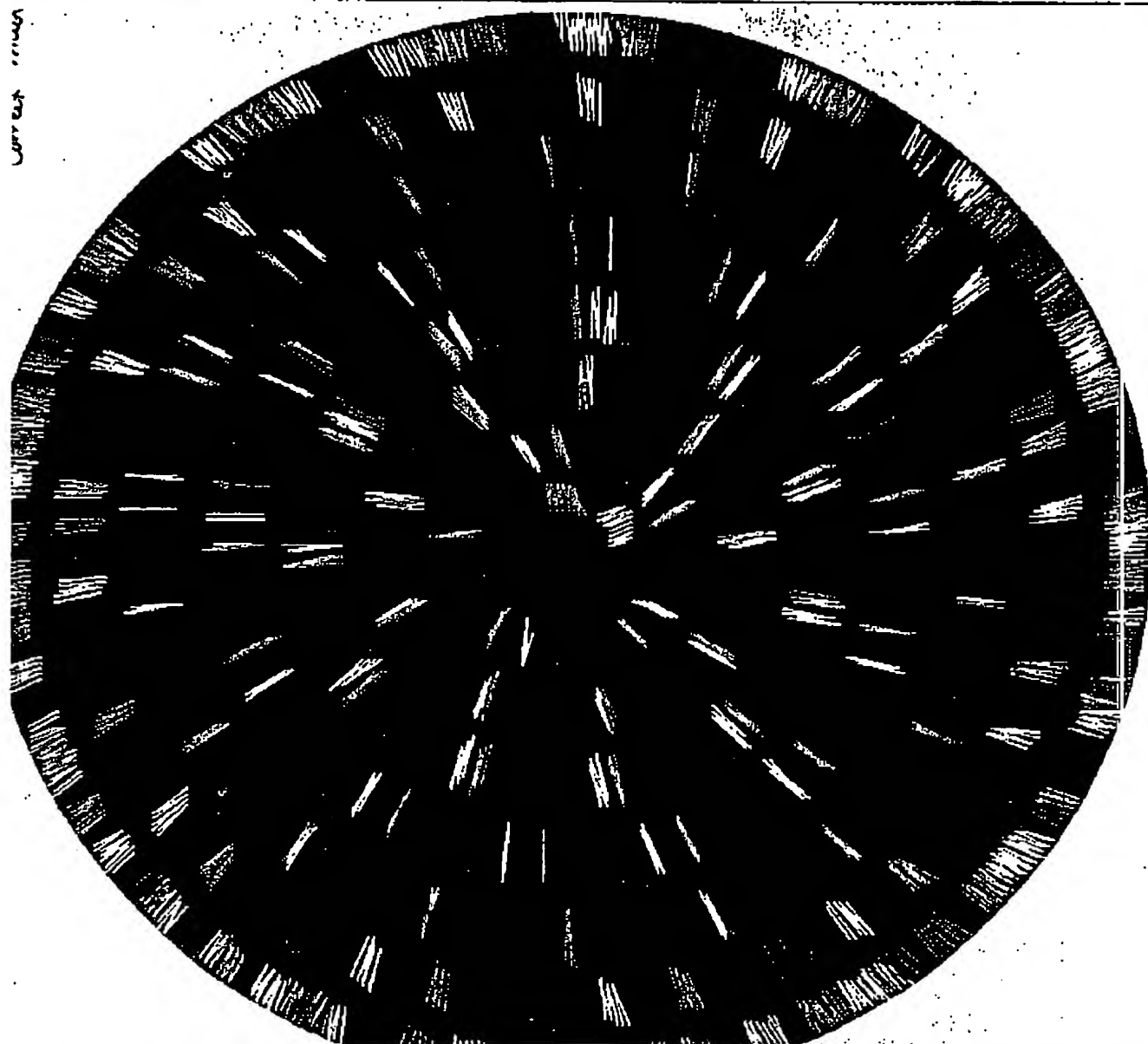
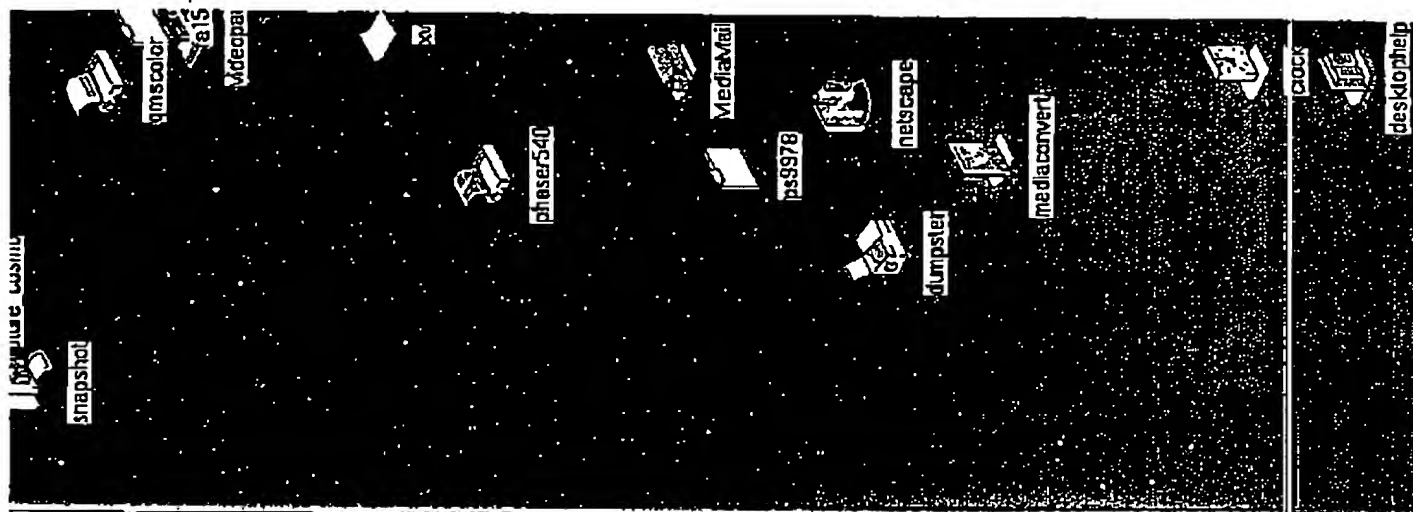
EPA 1293

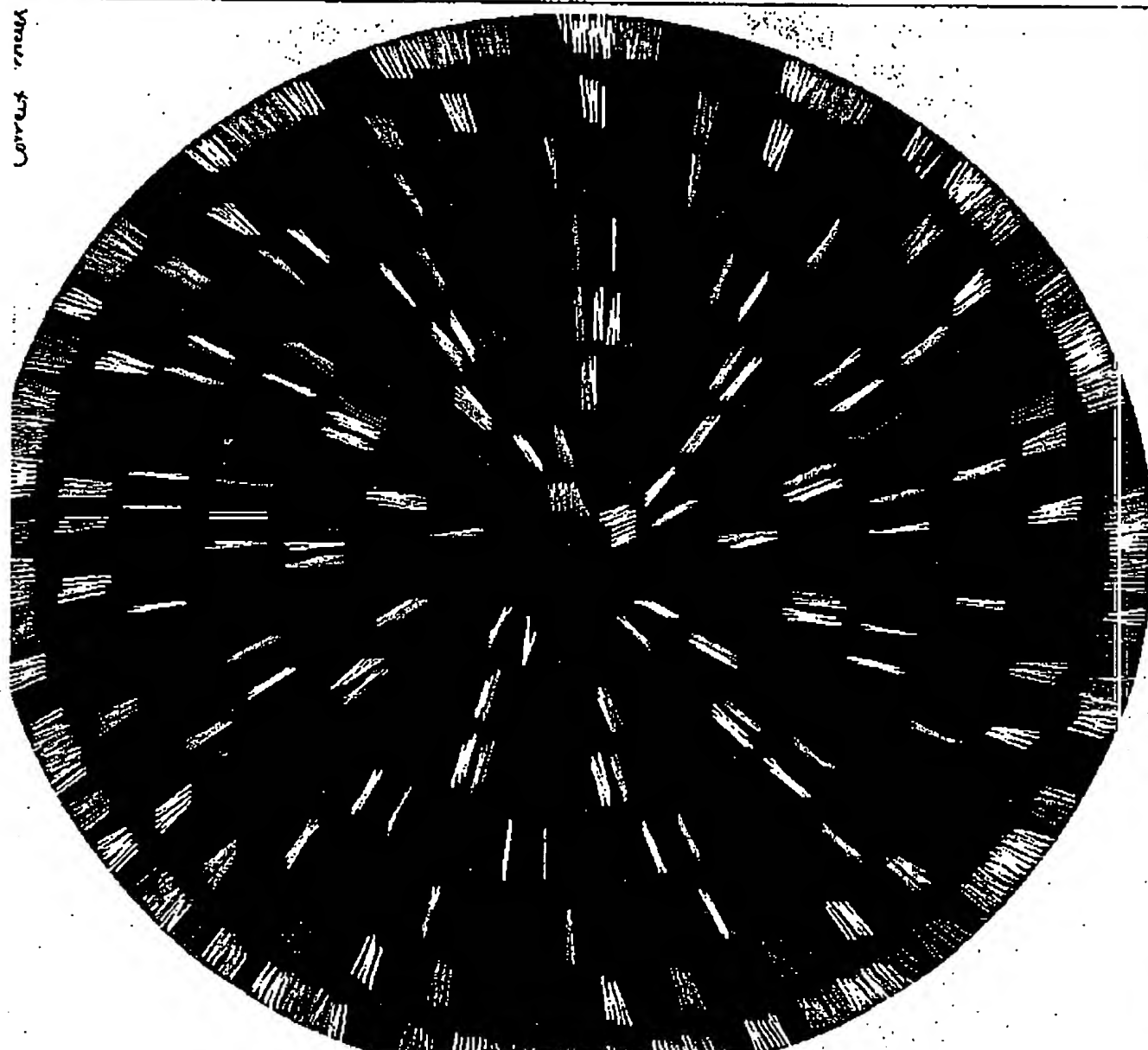
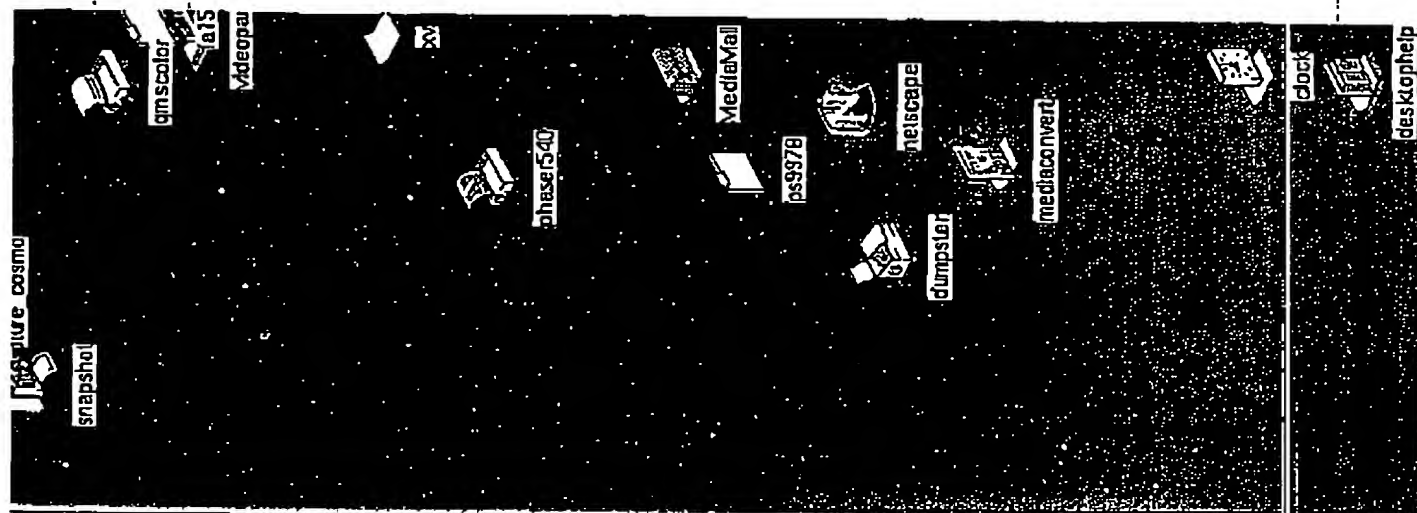
F15h ER5754

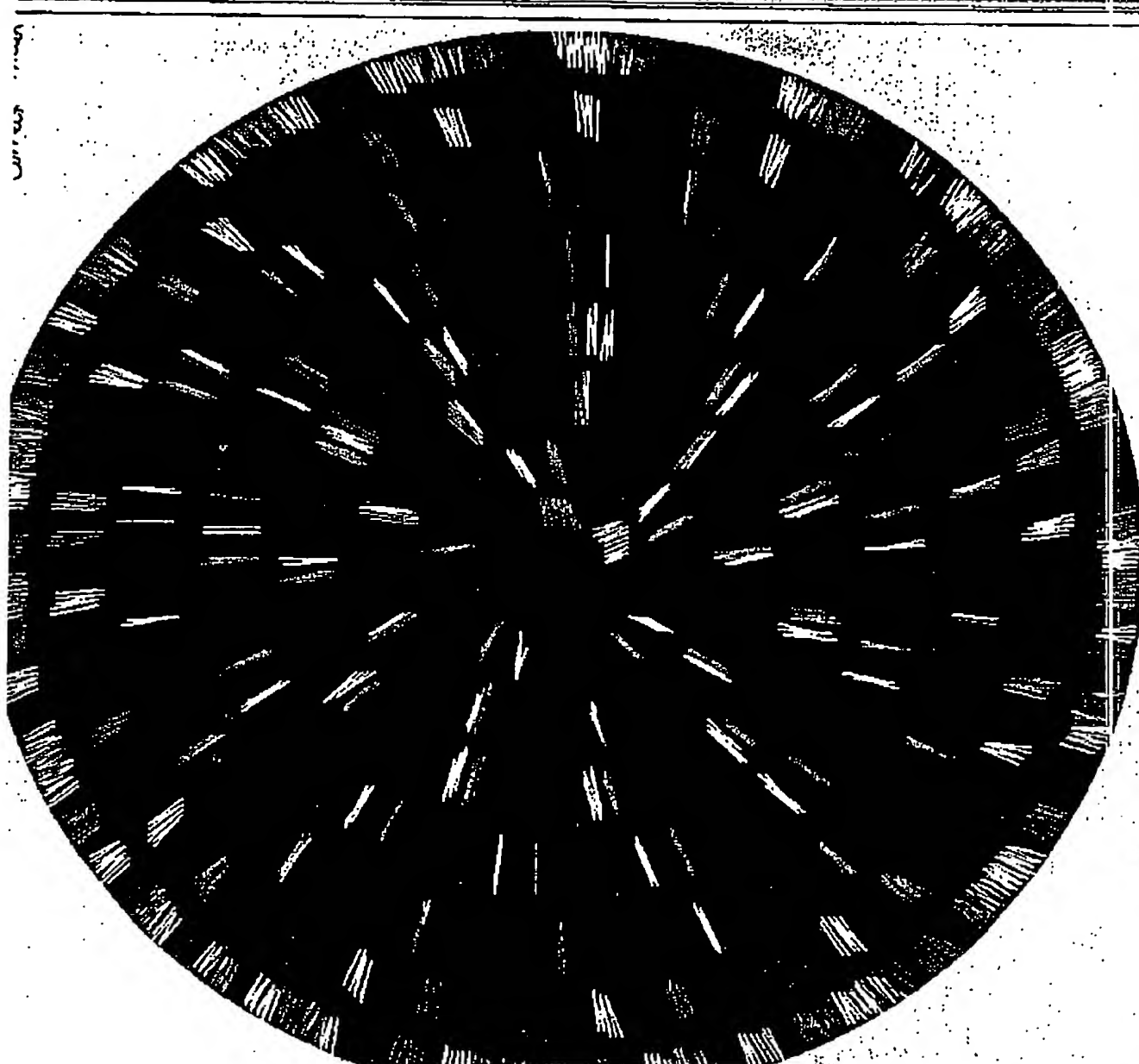
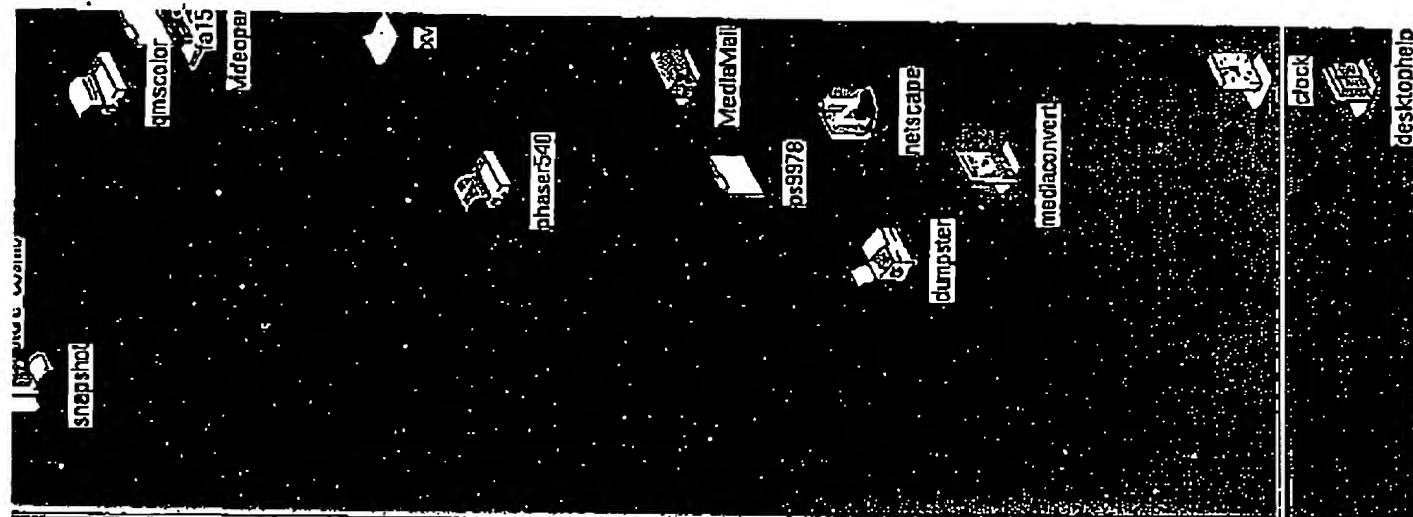


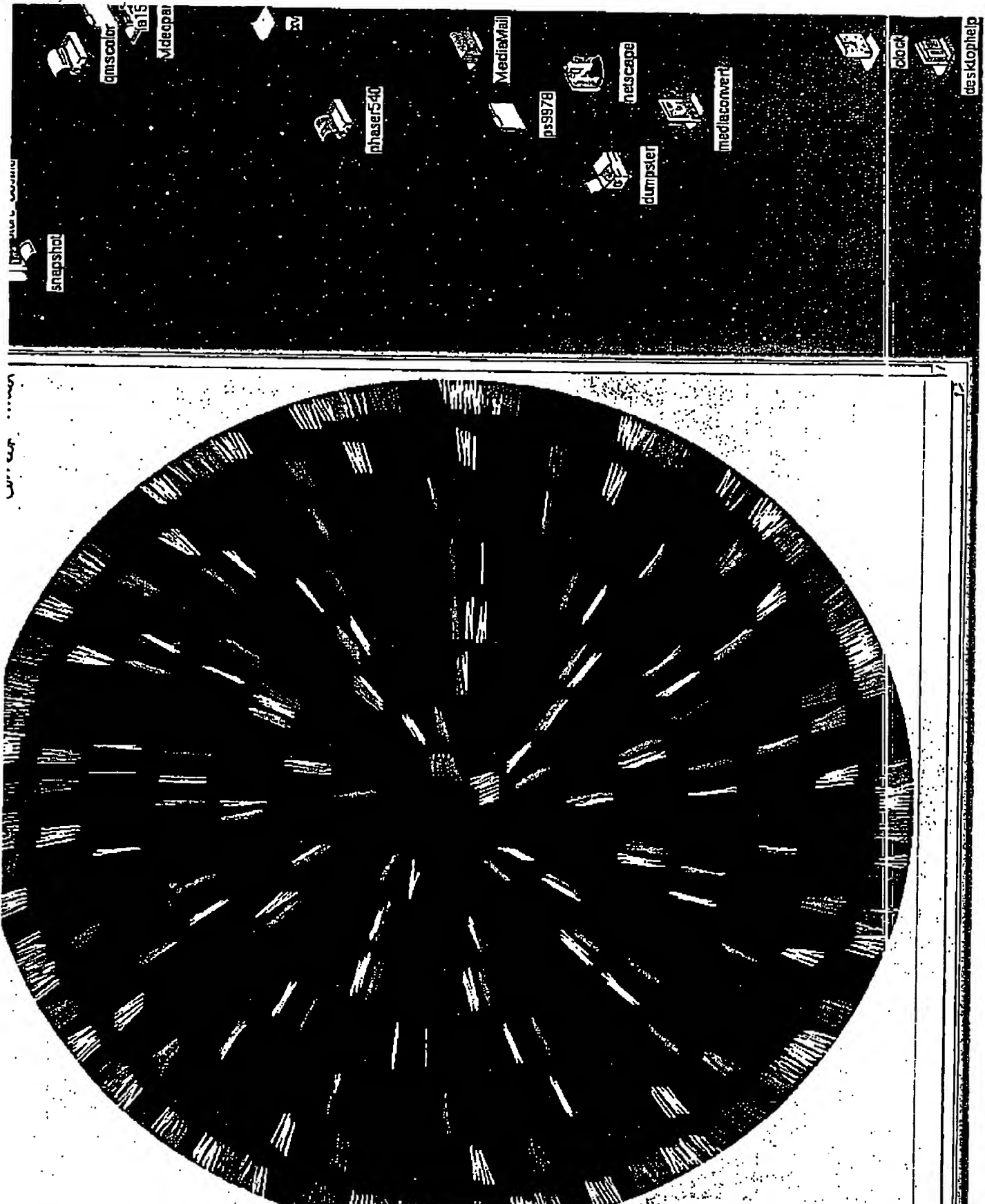


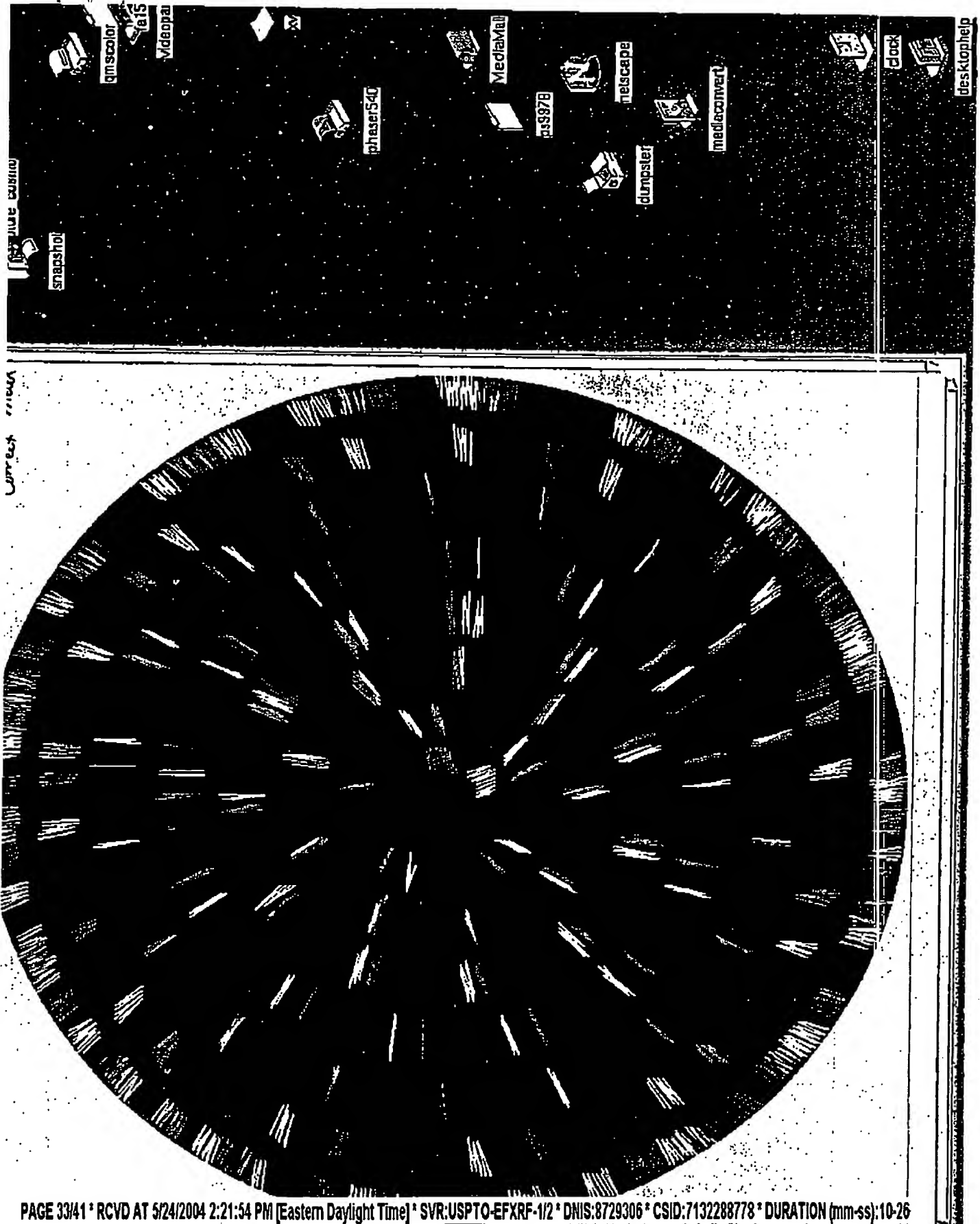


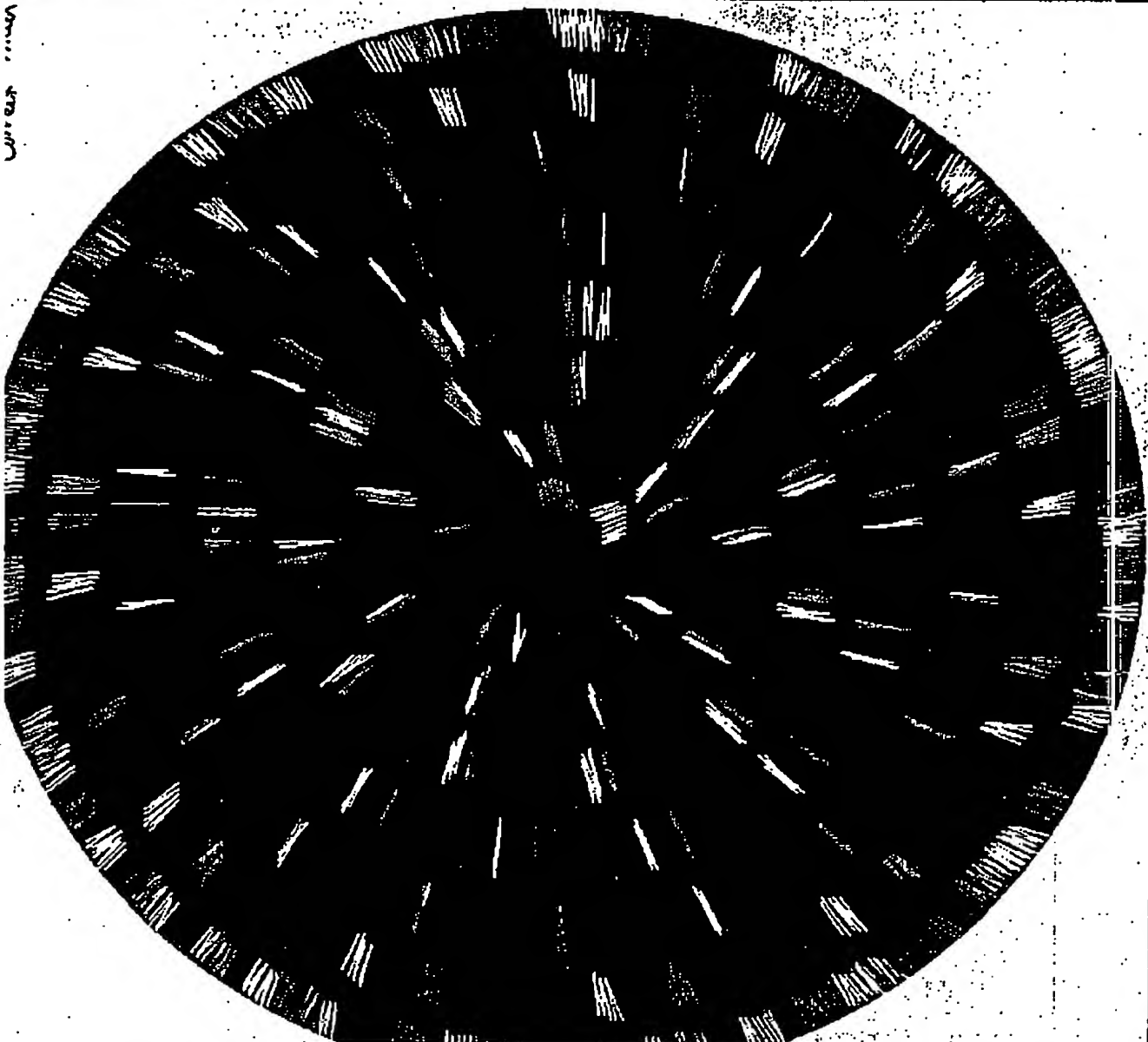
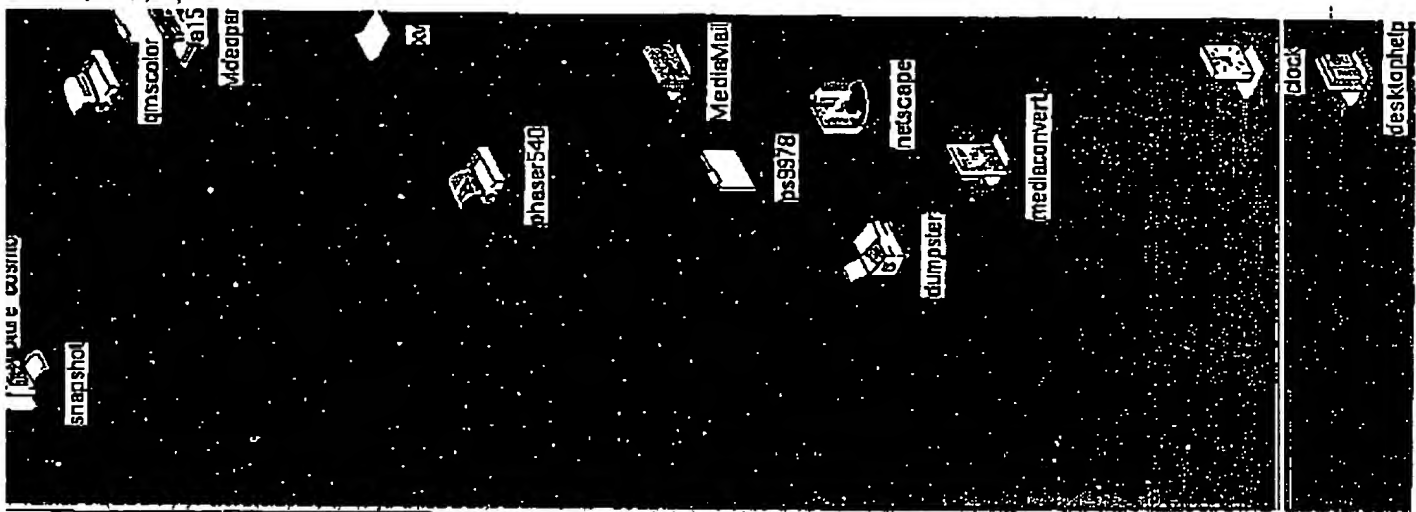


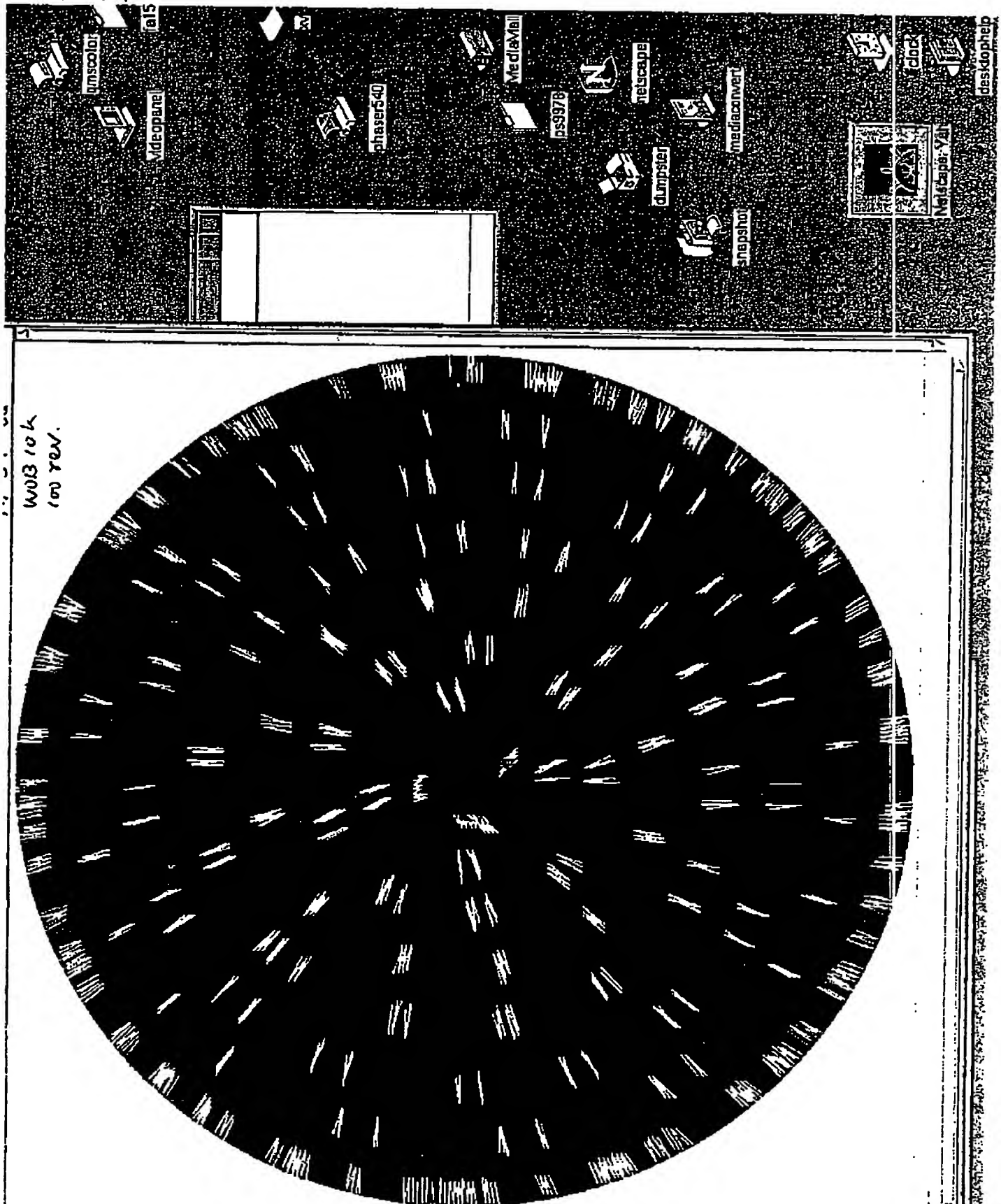












Calculation Summary

ct: ./f15h1aa
 ter of Bit: 7.87 (in) [200 (mm)]
 t on Bit: 42000 (lbf) [19051 (kgf)]
 utions per minute: 85 (rpm)
 utions of Simulated: 30 (rev)
 ess coefficient of Rock: 134954 (lbf/in2) [930.5 (Mpa)]
 ritical Contact Depth of Rock: 0.054 (in) [1.4 (mm)]
 breakage Factor of Rock: 95.006 (Mpa/mm)
 ole ar a: 48.707 (sq.in)

CutArea Coverage
(sq.in) %

15.17	31.14
16.91	34.71
18.68	38.35
18.26	37.48
18.62	38.22
20.64	42.37
20.80	42.70
20.67	42.44
20.49	42.06
20.90	42.91
22.05	45.27
20.75	42.60
20.94	42.99
21.75	44.66
21.96	45.08
21.39	43.92
20.92	42.95
21.04	43.19
21.31	43.76
20.39	41.87
20.88	42.87
21.13	43.38
21.04	43.20
20.42	41.93
21.65	44.45
21.18	43.48
21.44	44.03
21.17	43.45
21.24	43.61
21.24	43.61

ge of Coverage for Bit: 42.09 %

ge of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.886	3.937	0.002	0.12	0.00
2	3.726	3.937	0.019	0.36	0.04
3	3.154	3.851	2.148	14.02	4.41
4	2.055	2.815	3.266	28.08	6.71
5	0.773	1.428	0.829	18.30	1.70
6	0.210	0.704	0.034	2.40	0.07
1	3.884	3.937	0.005	0.36	0.01
2	3.484	3.937	1.838	17.40	3.77
3	2.488	3.247	3.813	27.88	7.83
4	1.205	1.852	1.550	24.95	3.18
5	0.229	0.690	0.045	3.38	0.09
1	3.884	3.937	0.003	0.24	0.01
2	3.534	3.937	0.388	4.09	0.80
3	2.832	3.595	3.777	24.51	7.76
4	1.595	2.319	2.497	28.04	5.13
5	0.429	0.972	0.212	8.90	0.44

penetration Depth 0.249 (ft) [76 (mm)]

1.2176

1.2581

1.2223

ing Brittle File Size 5003400 (bytes)

cal Brittle File Size 3705012 (bytes)

Contacted Times 849 (times)

ct Percentage of Shell to Rock 23.5833 %

Calculation Summary

ct: ./f15h17
 ter of Bit: 7.87 (in) [200 (mm)]
 t on Bit: 42000 (lbf) [19051 (kgf)]
 utions per minute: 85 (rpm)
 utions of Simulated: 30 (rev)
 ess coefficient of Rock: 134954 (lbf/in2) [930.5 (Mpa)]
 ritical Contact Depth of Rock: 0.054 (in) [1.4 (mm)]
 rebreakage Factor of Rock: 95.006 (Mpa/mm)
 ole area: 48.707 (sq.in)

CutArea Coverage
(sq.in) %

13.15 27.00
 13.45 27.62
 15.99 32.83
 17.90 36.75
 19.16 39.34
 18.72 38.44
 18.10 37.16
 19.03 39.08
 19.44 39.92
 18.89 38.77
 19.97 41.01
 19.35 39.72
 18.09 37.13
 18.30 37.58
 18.84 38.69
 18.07 37.09
 19.37 39.77
 19.20 39.41
 19.96 40.98
 19.21 39.44
 19.38 39.79
 20.33 41.74
 18.94 38.88
 19.49 40.01
 19.73 40.51
 19.20 39.42
 19.99 41.04
 19.19 39.40
 20.25 41.57
 19.06 39.14

ge of Coverage for Bit: 38.31 %

ge of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.907	3.937	0.000	0.00	0.00
2	3.318	3.937	1.161	8.22	2.38
3	2.884	3.572	2.868	20.54	5.89
4	1.377	2.045	2.072	28.87	4.25
5	0.105	0.554	0.064	6.85	0.13
1	3.890	3.937	0.000	0.00	0.00
2	3.323	3.937	2.096	14.95	4.30
3	1.848	2.593	2.978	28.63	6.11
4	0.454	1.014	0.367	14.24	0.75
1	3.907	3.937	0.000	0.00	0.00
2	3.321	3.937	1.707	12.15	3.50
3	2.387	3.150	3.813	28.75	7.83
4	0.899	1.533	1.316	27.14	2.70

enetration Depth 0.149 (ft) [45 (mm)]

ge of ROP 23.44 (ft/h) [7.14 (m/h)]

of Cone Rotary Speed to Bit:

Ratio

1.2623

ing Brittle File Size 3660912 (bytes)
cal Brittl File Size 2933052 (bytes)
Contacted Times 1694 (times)
ct Percentage of Shell to Rock 47.0556 %

Peer Review

Project Information

Page: 1

Title: 077 mf15h

Number: CS-P-15

Leader(s): YING XIANG

Meeting Schedule

Date: Mar.30, 1999

Time: 9.00AM

Place: ROOM2000

Meeting Objectives

Design review

Agenda Topics

Time Allotment

- | | | | | | |
|--------------------------------|------------------------------|------------------------------|------------------------------|---|--------|
| Review Product Brief | <input type="checkbox"/> PDP | <input type="checkbox"/> ECR | <input type="checkbox"/> CAR | <input checked="" type="checkbox"/> EPA | 0 |
| Review 077-mf15h -93 Layout | | | | | 45 min |
| p n discussion | | | | | 15 min |
| | | | | | 30 min |
| | | | | | |
| | | | | | |
| Recap Meeting and Action Items | | | | | 5 min |

Attendees: (Attendance indicated by signature)

Name:	Signature:	Name:	Signature:
Jim Minikus		John Williams	
Gary Garcia		Dennis Cisneros	
Fred Garbrecht		Gary Portwood	
Cott McDONOUGH		Paul Wood	
van Chenevert			
WILLIE OLIVER			

Design Review Results

- | | | |
|---|--|---|
| <input type="checkbox"/> Unconditional Approval
(No change required) | <input checked="" type="checkbox"/> Conditional Approval
(Action items must be completed) | <input type="checkbox"/> Another Design Review Required
(Redesign and conduct another design review) |
|---|--|---|

Certification:

Manager/Supervisor Signature:

Date: 12 APR 99

Peer Review

Project Information:

Page 2

Title: 077mf15h

Number: CS-P-15

Date: March 30, 1999

Action Items:

- 1) FORGING LOCATION INCORRECT ON LAYOUT (ADJUST TO CORRECT LOCATION → REF - 03 LAYOUT)

Action Taken:

Correct it to the right position.

- 2) ADJUSTHEEL ANGLE TO ALLOWHEEL INSERT TO BE DRILLED ON "FLAT" SURFACE

Action Taken:

Yes, did it.

- 3) VERIFY 3D CLUSTER CLEARANCES.

Action Taken:

3D cluster clearance is checked. It's OK.

- 4) ADD MILLING TO NO. 1 CONE "D" ROW (MILLED FLAT)

Yes, did it.

Action Taken:

- 5) ADJUST START ANGLES ON #1D, 1F, 2E, 3C & 3E ROWS

Yes, changed.

Action Taken:

- 6) ADJUST HOLE DEPTH ON #1E TO NON-STANDARD (HOLE DEPTH IS DEEPER THAN .280 SHOWN IN THE INSERT TABLE).

Action Taken:

No need, just changed flat heel.

- 7) REMOVE RADIUS FROM CONE BACKFACE TO HEEL SURFACE TRANSITION.

Yes, did it.

Action Taken:

- 8) USE S10 GRAMS ON 2D ROW (GAGE)

Yes, did it.

Action Taken:

Action Items Addressed:

Project Leader's Signature:

Ying Xing

Date:

4-12-99

Peer Review

Project Information:

Page: 3

Title: 077mf15h

Number: CS-P-15

Date: March 30, 1999

Action Items:

9) CHANGE HEE TO "FLAT" + "FLUSH" STYLE SIMILAR TO
PREVIOUS CTS (5130, 5680, 5743). USE 3/16" IN #1 CONE (IF NECESSARY)

Action Taken:

yes. did it.

10) INCREASE GROOVE RADIUS ON 2C-D GROOVE.

yes. did it.

Action Taken:

Action Taken:

Action Taken:

Action Taken:

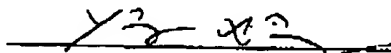
Action Taken:

Action Taken:

Action Taken:

Action Items Addressed:

Project Leader's Signature:



Date:

4-12-99



Smith International, Inc.

Page 1 of 2

4/13/99

CONFIDENTIAL << ER TEST PLAN >> FOR INTERNAL USE ONLY <<

Number: 5754		INCOMPLETE		04/13/99		Date Revised: 04/13/99	
077	Type: MF15H	Mfr: STC	EO: 23482	Project: CS-P-15		Product Type: RDF	
1:	BOM 2:	BOM 3:	Plant:	Project Engineer: YING		XIANG	
TER: NEW CUTTING STRUCTURE							

Description:

Testing structure design based on Ideas analysis tools. three gages rows on three cones are in the different locations, with different diameters, sizes, and grades. The profile is very different from existing f15h bit.

ISSUED

APR 21 1999

ENGRG. HOUSTON

sed DRB Date: 00/00/00	Quantity of Runs for Rigorous Test Analysis:		
igation Date: 00/00/00	PM Prioritization Date: 00/00/00	DDQP Date: 00/00/00	EO Completion Date: 00/00/00

DISTRIBUTION OF RIGOROUS TEST BITS

District Code	District Name	Est. Production	Quantity
		00/00/00	

DESIGN OVERVIEW

Needs Comments:

ROP from reed 51x bit

mark Comments:

P51X and HP51XM

and Measures Comments:

e market share of f15h bit. using ideas program as tool for new cutting structure development



Smith International, Inc.

Page 2 of 2

4/13/99

CONFIDENTIAL << ER TEST PLAN >> FOR INTERNAL USE ONLY <<**Operation and Lithology Comments:**

Try it first in the area where F15H standard bit drills softer formation, such as Canada. If the cutting structure holds itself, then it should be able to operate in other tough F15H bit area.

Drilling Practices and Conditions Comments:

Standard F15H drilling practices should work for this bit

ISSUED**APR 21 1999****ENGRG. HOUSTON****SPECIFIC DESIGN CHANGES/FEATURES****Description of each Change or Feature:**

Bit is total different from our standard F15H bit in inserts counts, row counts.

Objective of each Change or Feature:

Develop a bit which can compete with 51x without mud pick feature

FIELD ENGINEERING INSTRUCTIONS**Operational Parameters for ER Test Comments:**

Same as standard F15H and benchmark bits.

Drilling, Analysis, and Evaluation Requirement Comments:

Conditions, wear resistance, and ROP are the most important for evaluation

Bit Return Requirement Comments:

Run every bit to Houston for evaluation.

DESIGN REVIEW BOARD

Initial DRB Date: 00/00/00

DRB Results:

Design Review Board Comments:

ISSUED

2 2 1 1999

IG. HOUSTON

ENGINEERING ORDER

PoncaNO. 23412SHEET 1 OF 1REQUESTED DATE: 4-20-99E.R. NO. 5754

E.C.R. NO.

☐ NEW PRODUCT☒ NEW B.O.M. NO.☐ B.O.M. CHANGE☐ FORGING CHANGE☐ NEW BEARING NO.☒ NEW PART NO.☐ PART CHANGE☐ STATUS CHANGE☐ NEW FORGING NO.☒ NEW DWG. NO.☐ DWG. CHANGE☒ PRODUCT REDESIGNSIZE/TYPE 077 NF154BEARING NO. 525-0550TITLE new NF154 type bit design, different from other 754 design.PROJECT NO. CS-P-15

DESCRIPTION:

Create a new NF154 bit cutting structure (BOM 0024675). Three gage runs on three cones are at the different locations. #1 cone was S&T gage insert, two and three cones use RGC type inserts.

New cone assemblies, and new cone profile & drilling are required. One new insert required (P/A 0024675), which is the same shape and dimension as part 0022626, but different grade.

finished bits are to be marked on the top of the pin and on the bit box as ER 5754, which was on the bit type.

NEW	SUPERSEDES	OLD	NEW	SUPERSEDES	OLD
0 24598					

REASON: Research development product

DISPOSITION OF AFFECTED PARTS:

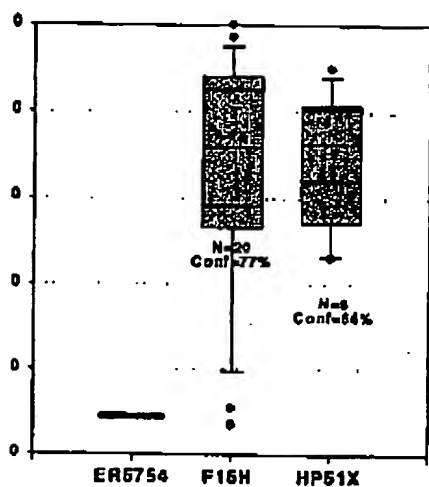
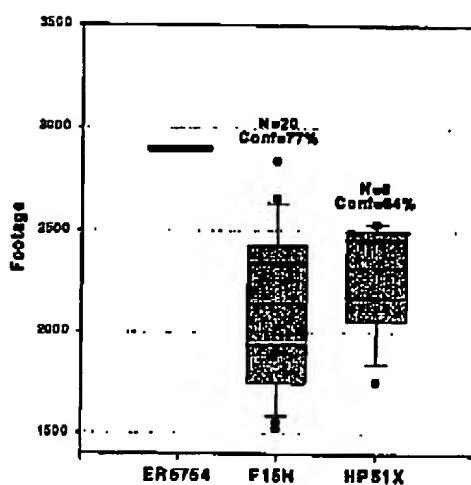
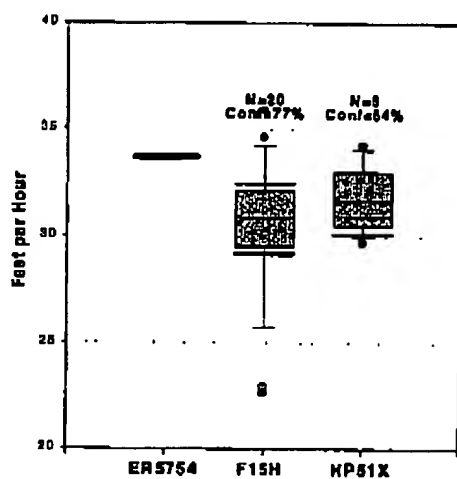
DRAWING NO	REV. UTR.	DRAWING NO.	REV. UTR.	PART NO.	REV. UTR.	BOM AFFECTED	REV. UTR.
#1 Assy		204326		0024679		0024598	
#2 Assy		204327		0024680			
#3 Assy		204328		0024681			
#1 P&D		204323					
#2 P&D		204324					
#3 P&D		204325					
Insert		0024675		0024675			

PREPARED BY:

BOBBY DANIEL

APPROVED BY:

[Signature]DATE: 4-20-99CONFIGURATION
MANAGEMENT

**Depth in Comparison
ER5754 - LX4911****Footage Comparison
ER 5754 - LX4911****ROP Comparison
ER5754 - LX4911**

ER5754

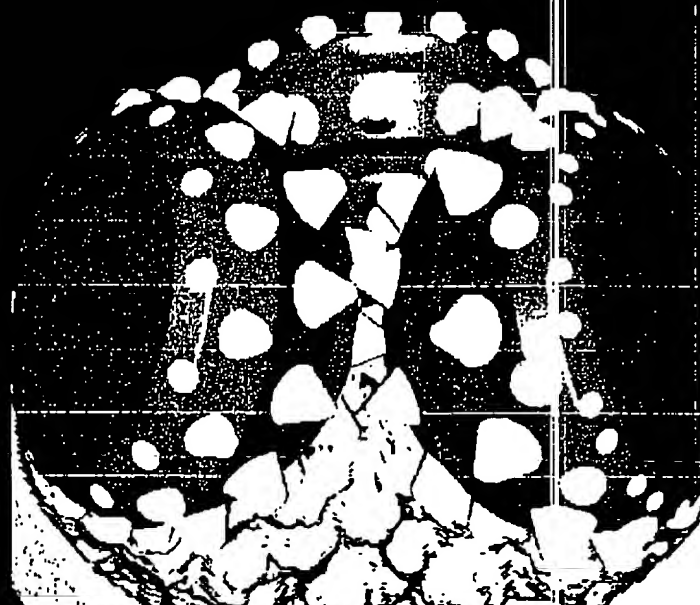
ER5754 came from a project named "HP51X killer" in 1999

THE FIRST IDEAS BIT

It was the first bit designed fully using IDEAS

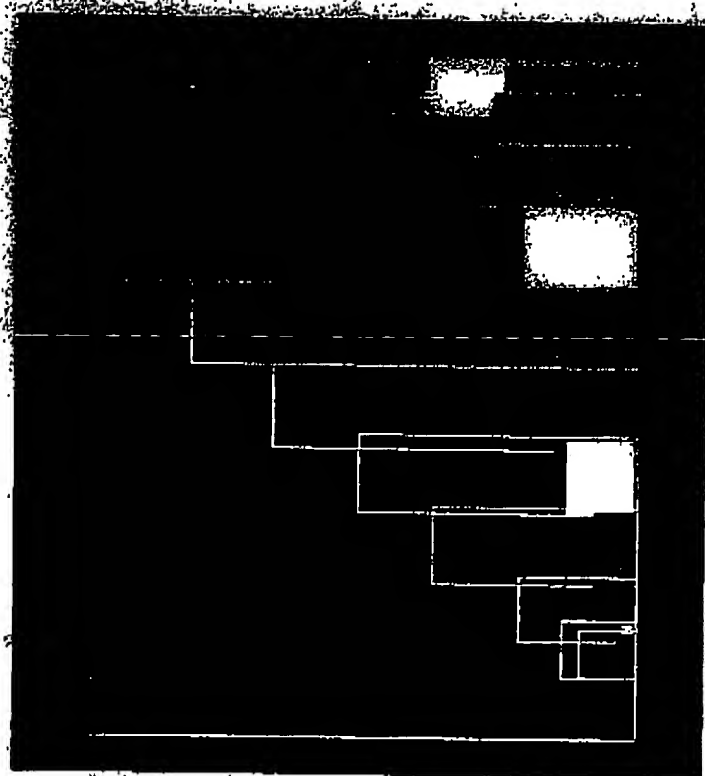
It hits homeruns in the fields of U.S. and Canada

It is also a HP53X killer

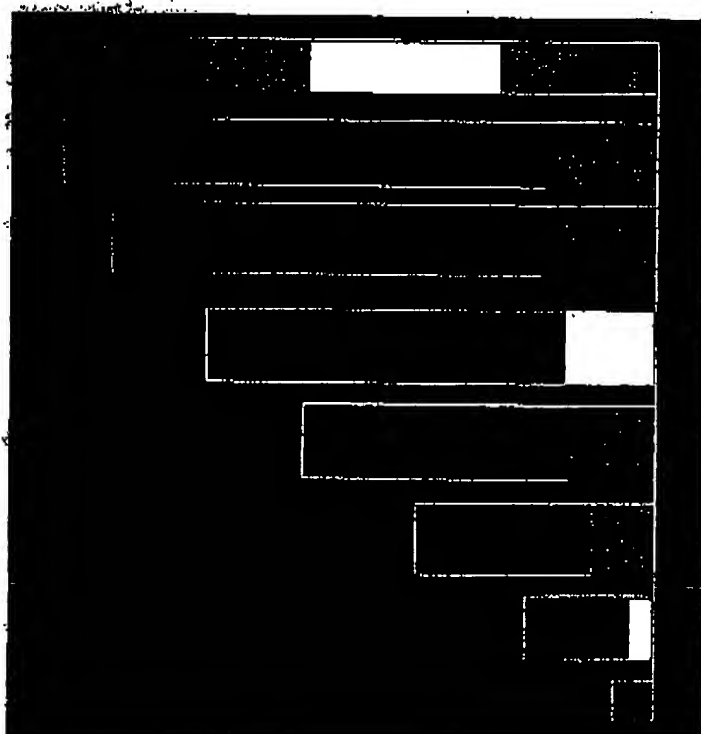


IDEAS™ Bit Design. 7 7/8 ER 5754

Bottom Hole Coverage Pattern



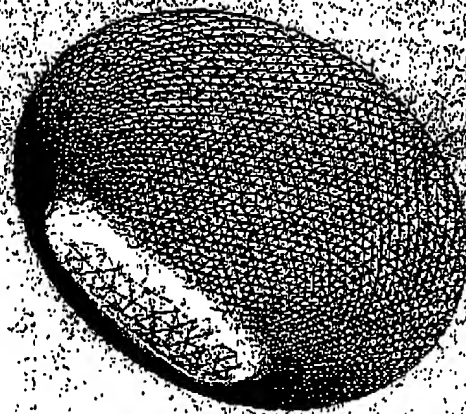
ER 5754



STD 7 7/8 ER 5754

Bit Optimization

Insert Sharpness, Shape, Counts And Wear Resistance



DEASTM Bit Design: 7 7/8 ER 5754

STD FLISH ER 5754

VOB	42k	42k
PM	85	85
op/ideas	23.44	38.7
ock Type	Shale	Shale
it Coverage	38%	42%
it Offset	.188	.219
isert Count	104	130
ow Count	11	13
isert Ext.	.37	.38

IDEAS™ Bit Design: 7 7/8 ERS754

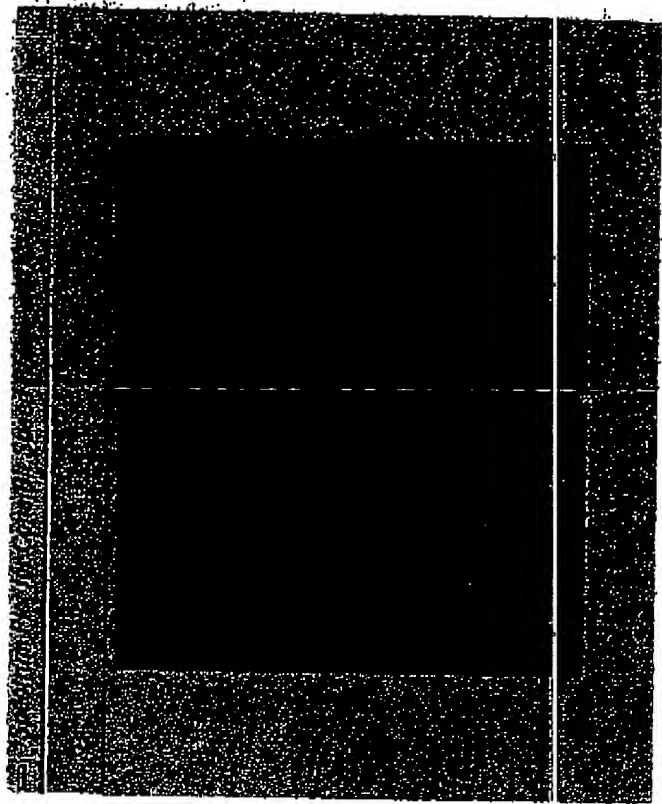
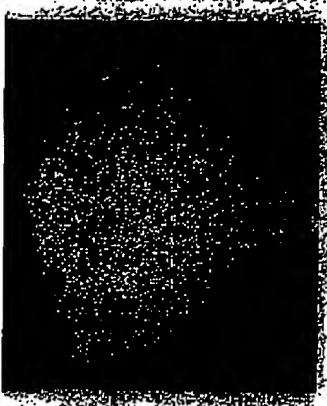
- Increased bit offset 219 vs. .188
- Unique gage configuration
- Aggressive profile with increased bottom hole coverage
- Sharper inner row insert
- Balanced cone-bit ratios
- Vertical force balanced
- Bottom hole pattern optimization

Bit Optimization

- Profile design
- Bottom hole pattern
- Insert sharpness, shape, counts and wear resistance
- Gage inserts configuration and efficiency
- General bit geometry

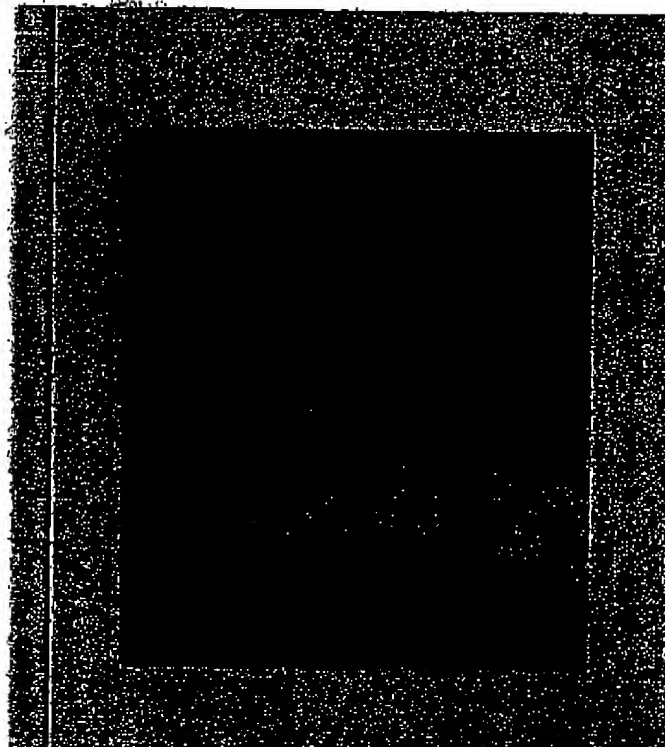
Bit Optimization

- Profile design
- Bottom hole pattern
- Insert sharpness, shape, counts and wear resistance
- Gage inserts configuration and efficiency
- General bit geometry



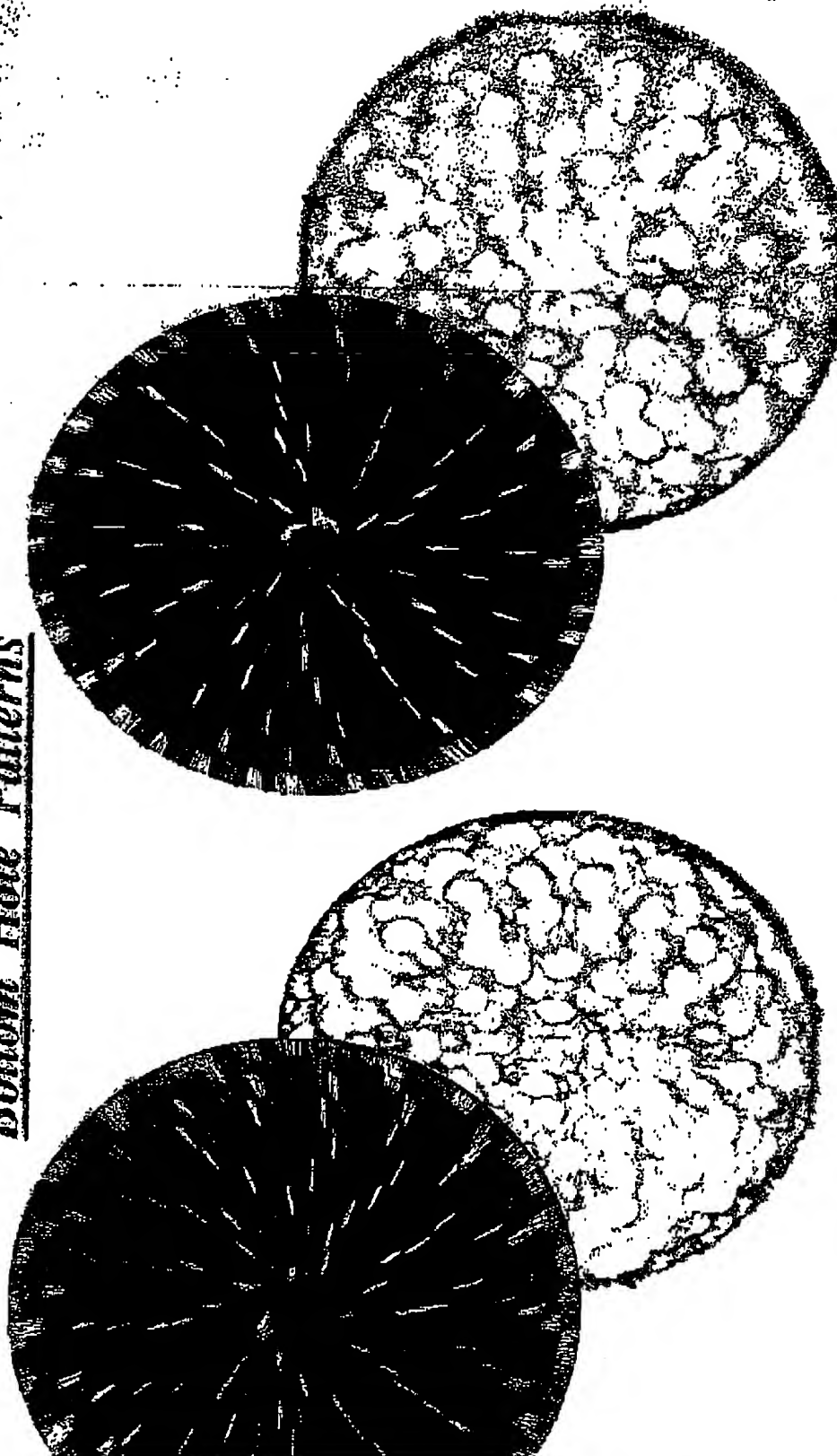
Bit Optimization

Bit/Cone Rotation Ratio



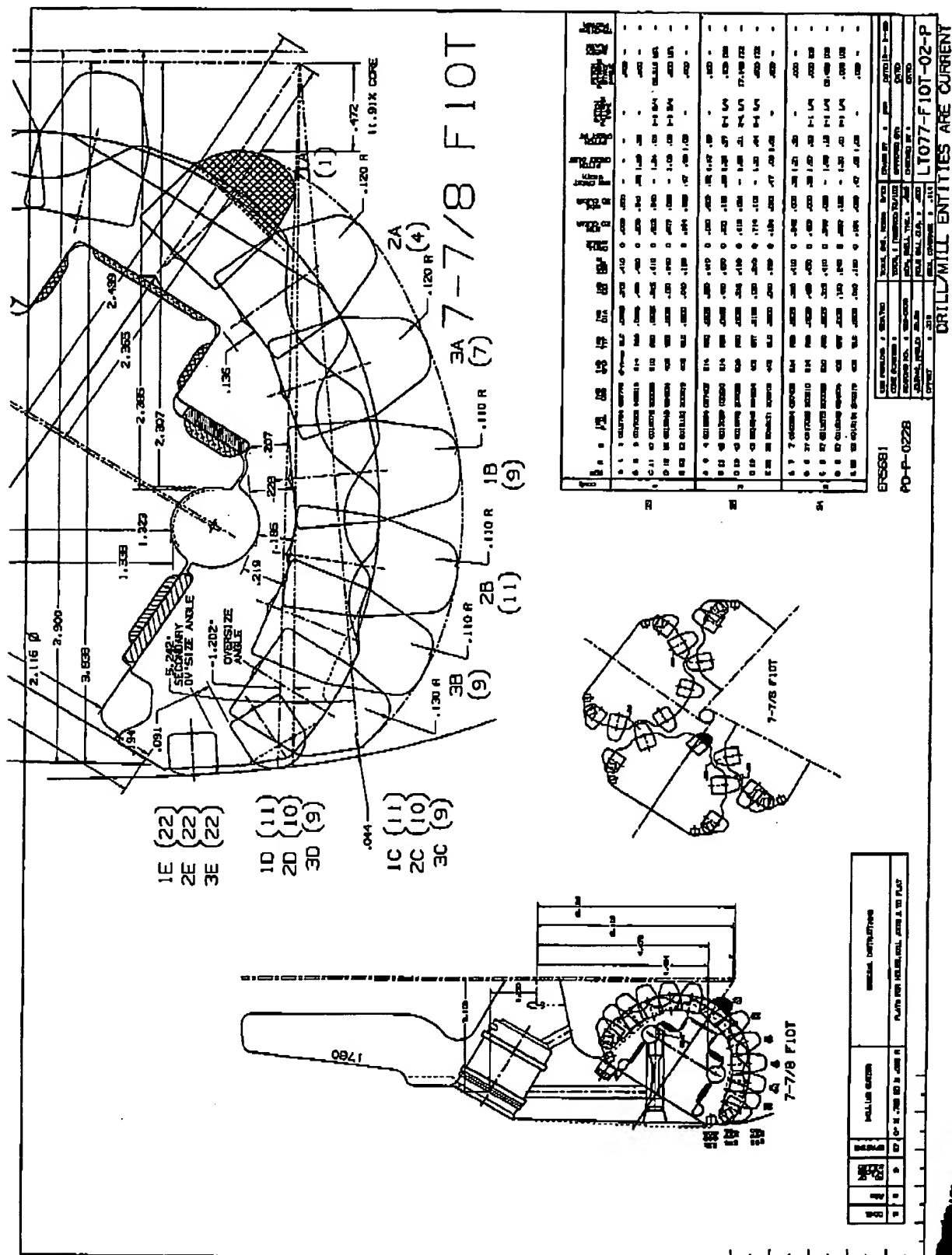
IDEAS™ Bit Design: 7 7/8 ER5754

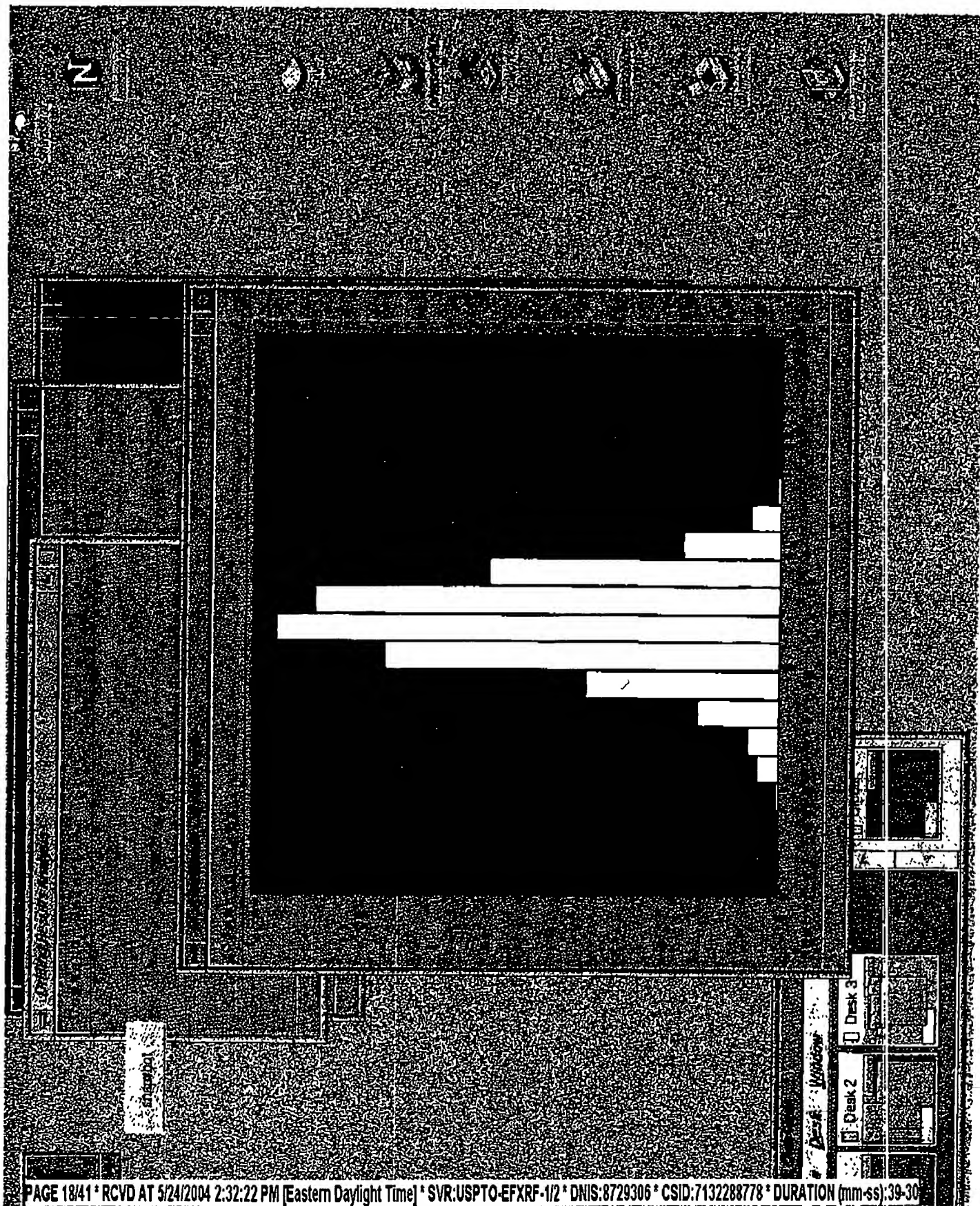
Bottom Hole Patterns

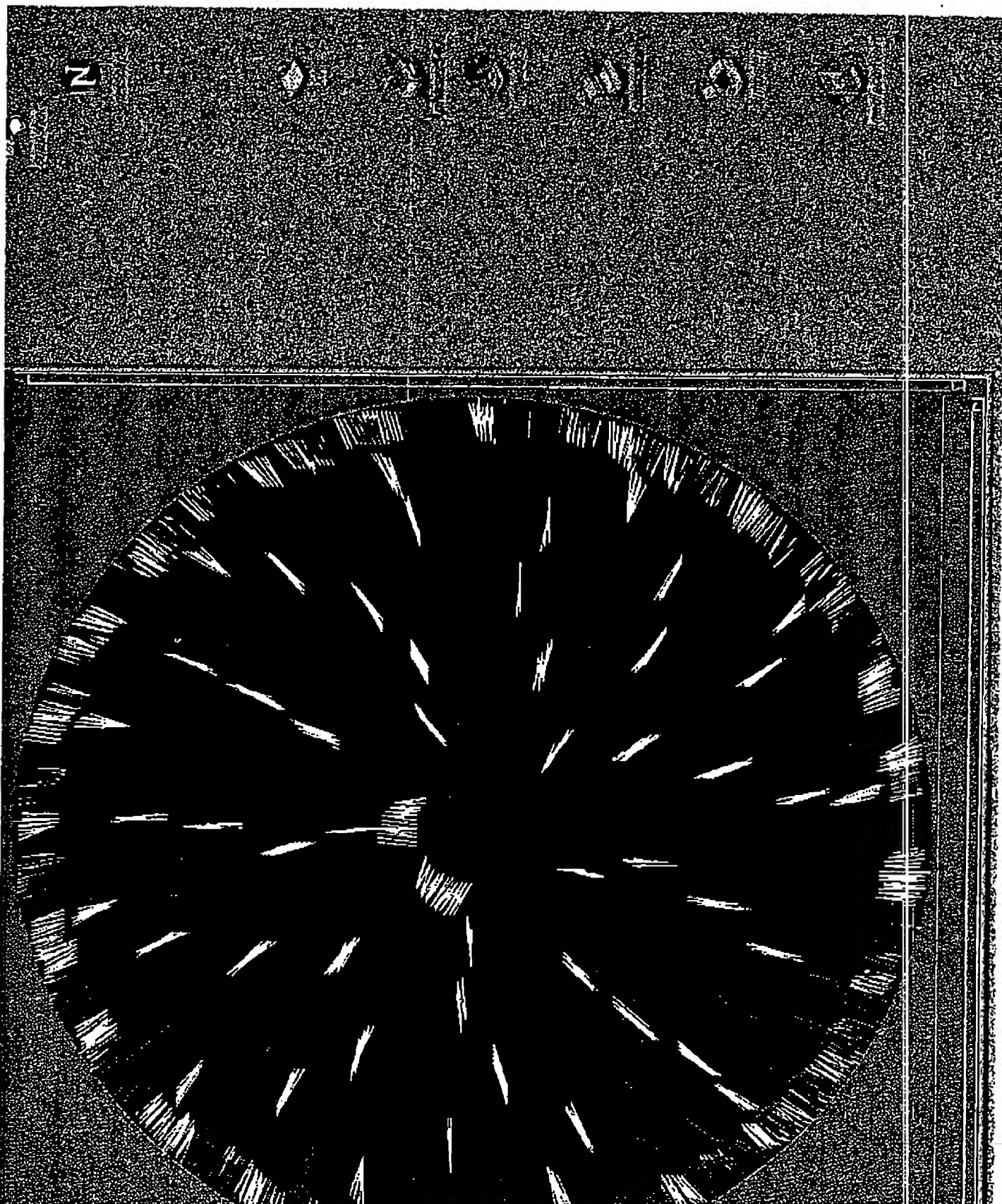


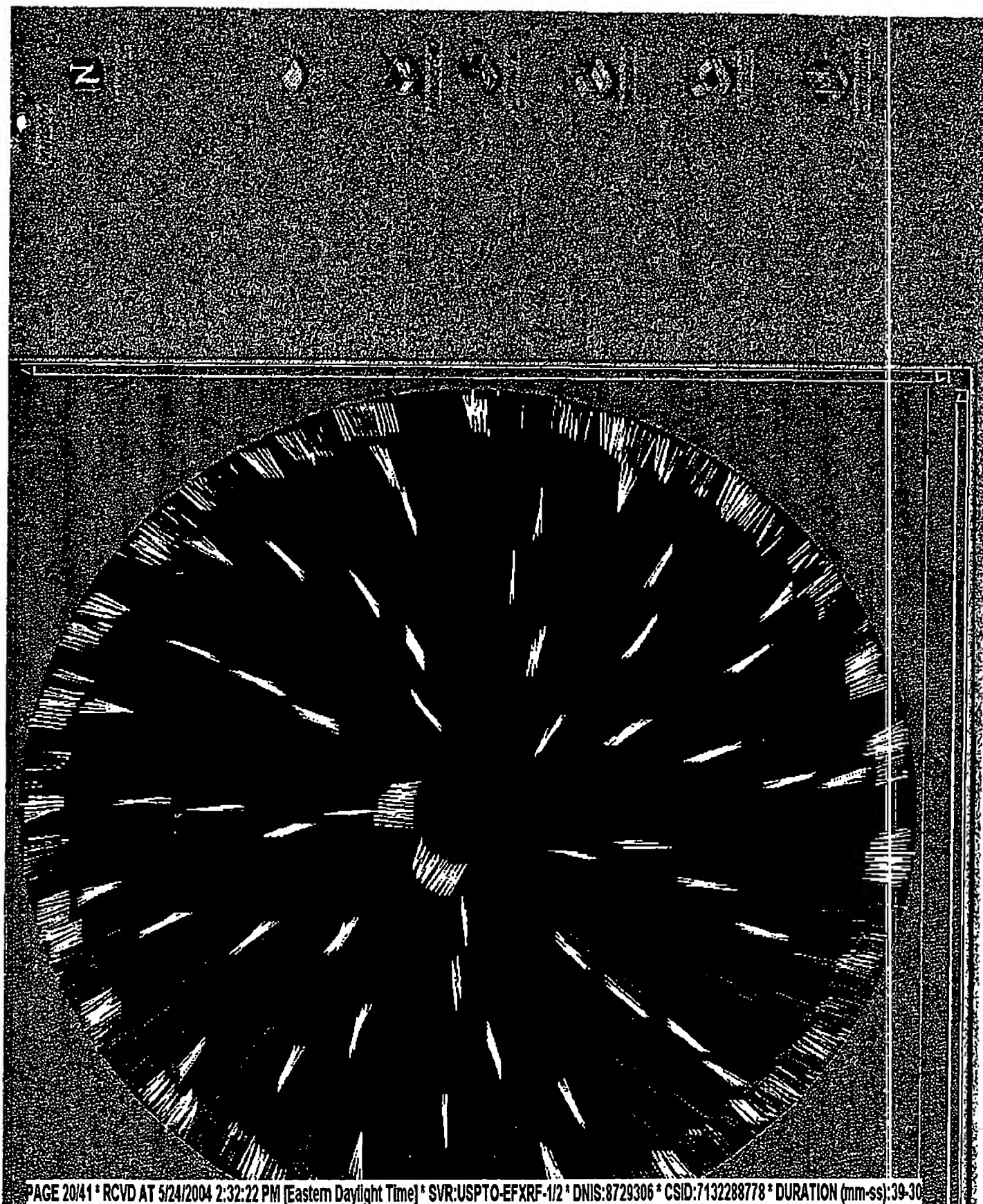
Standard 7 7/8 ER5754

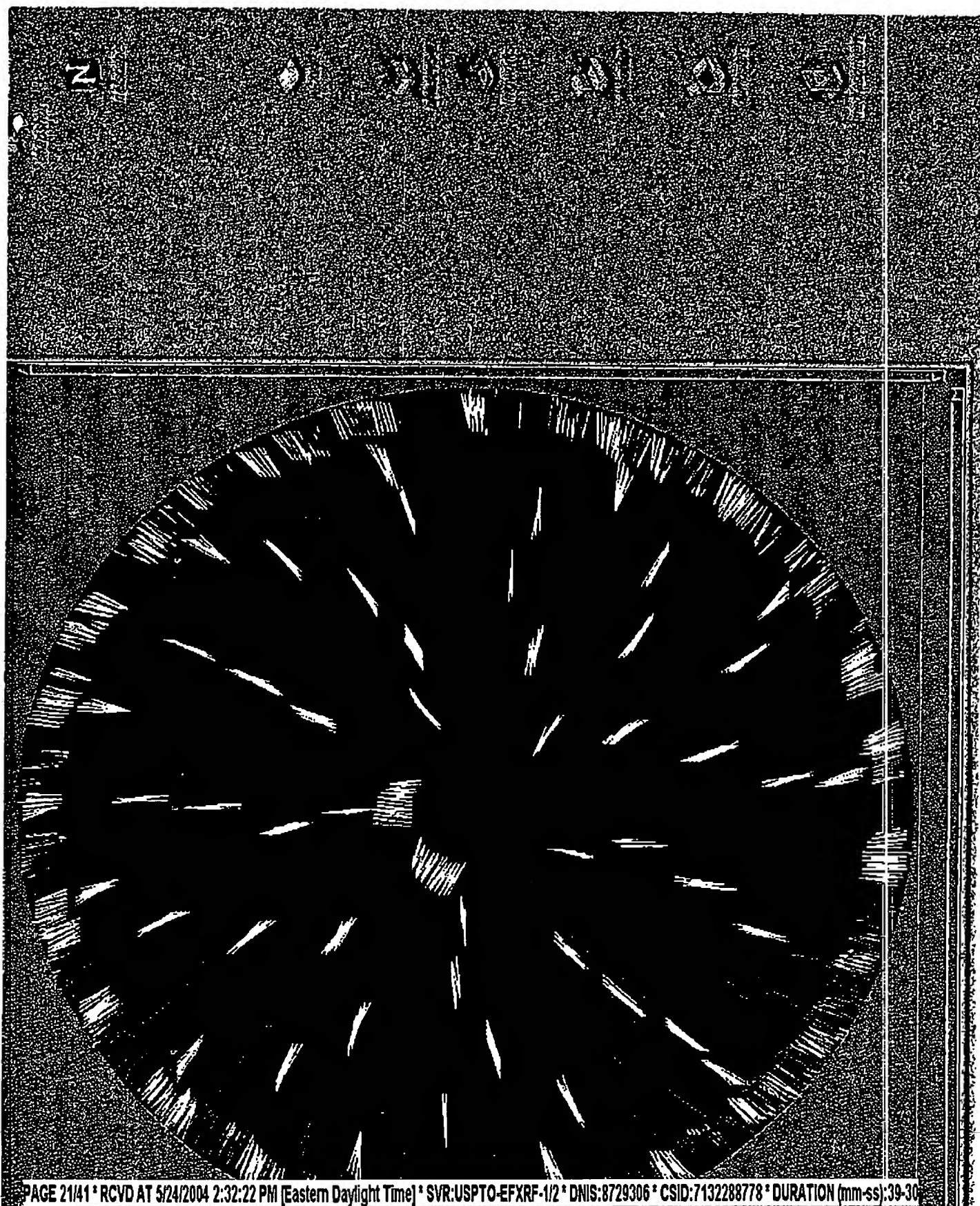
ER 5754

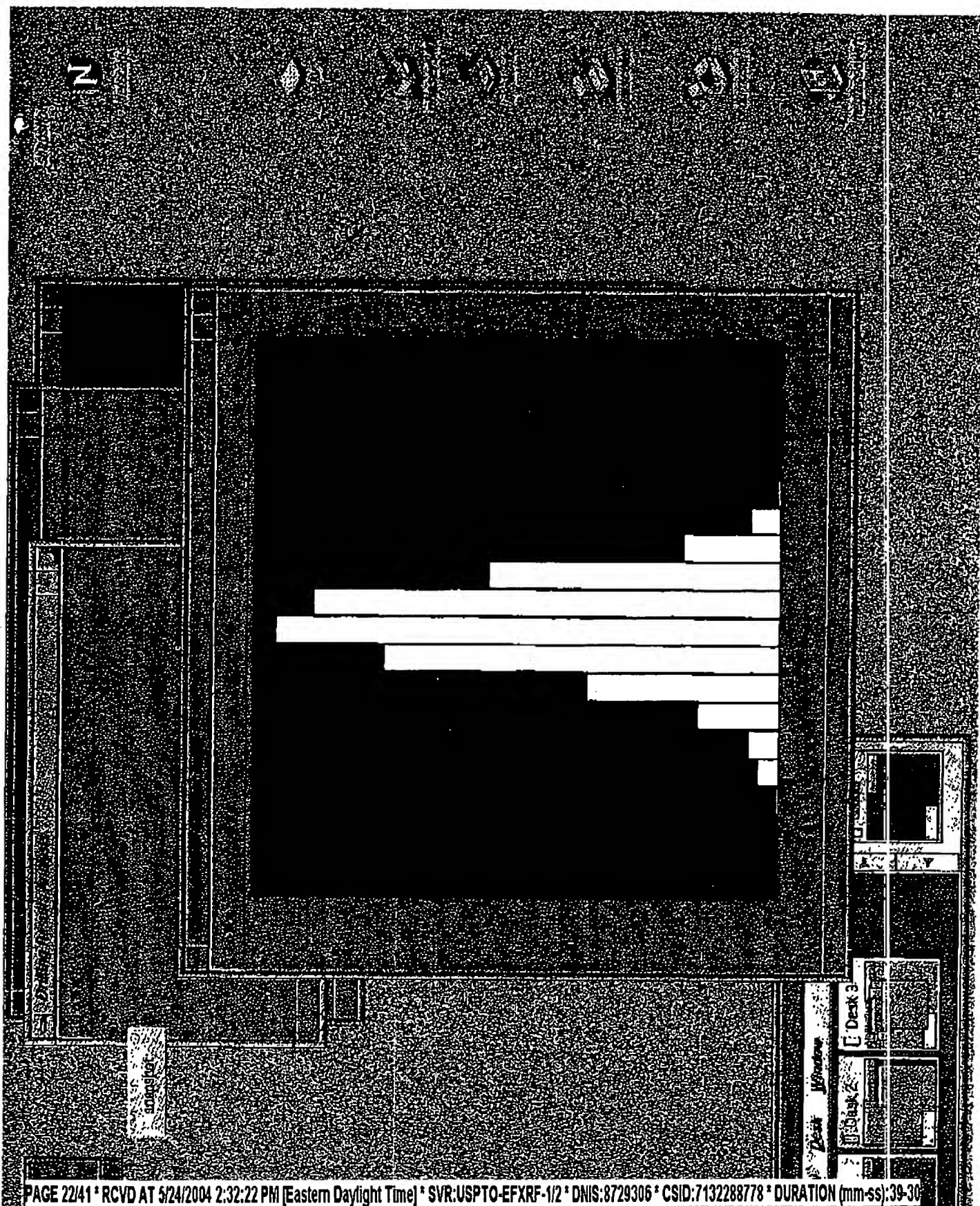


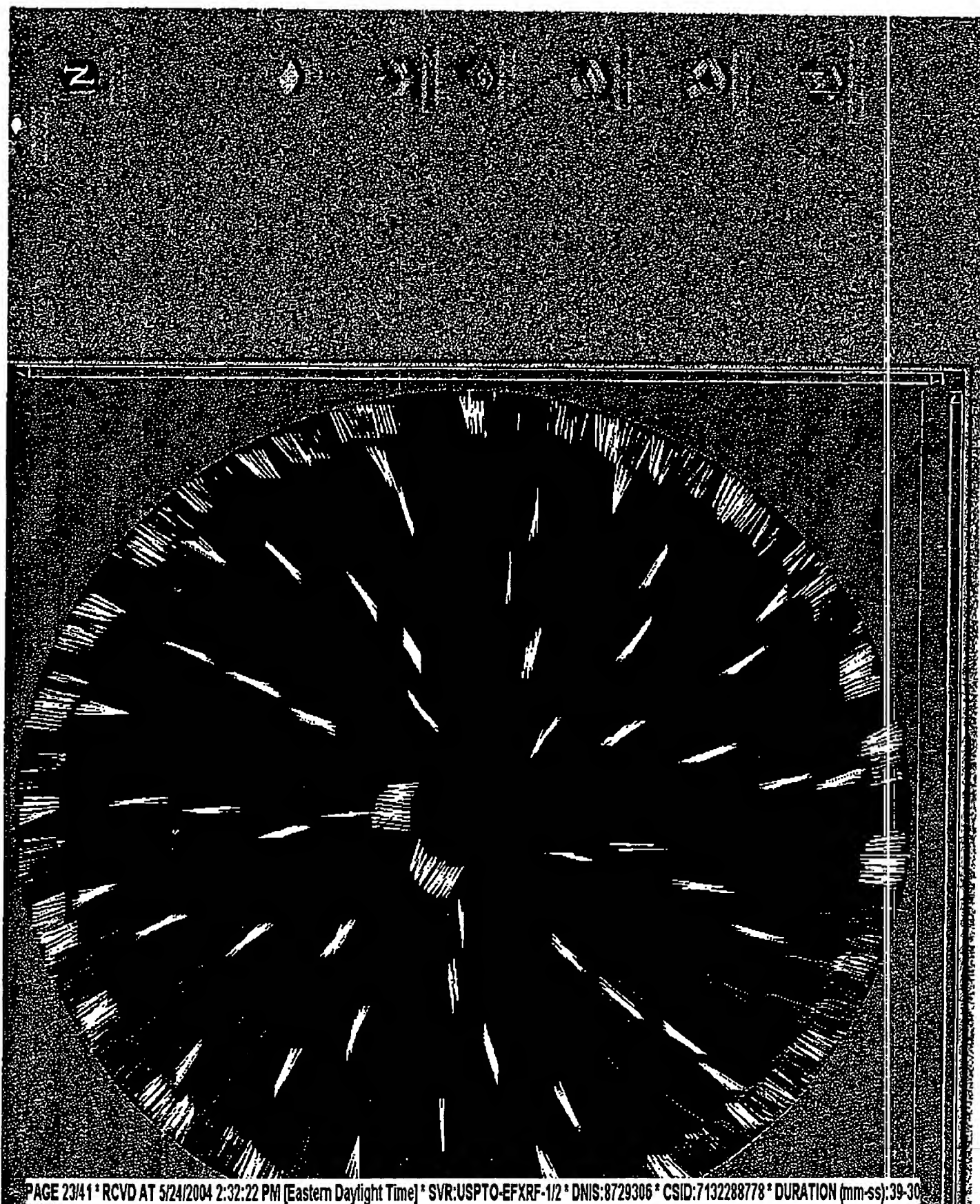


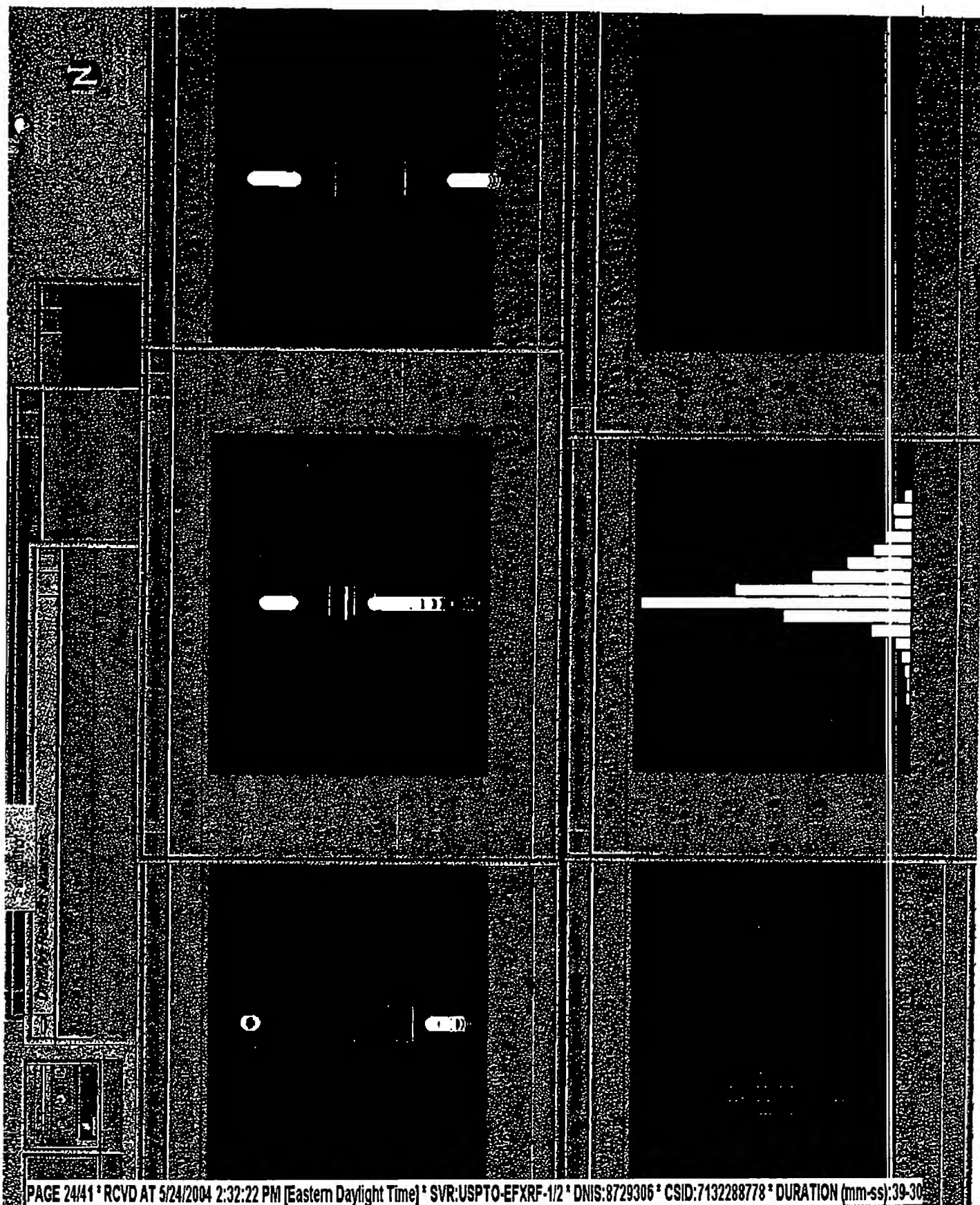


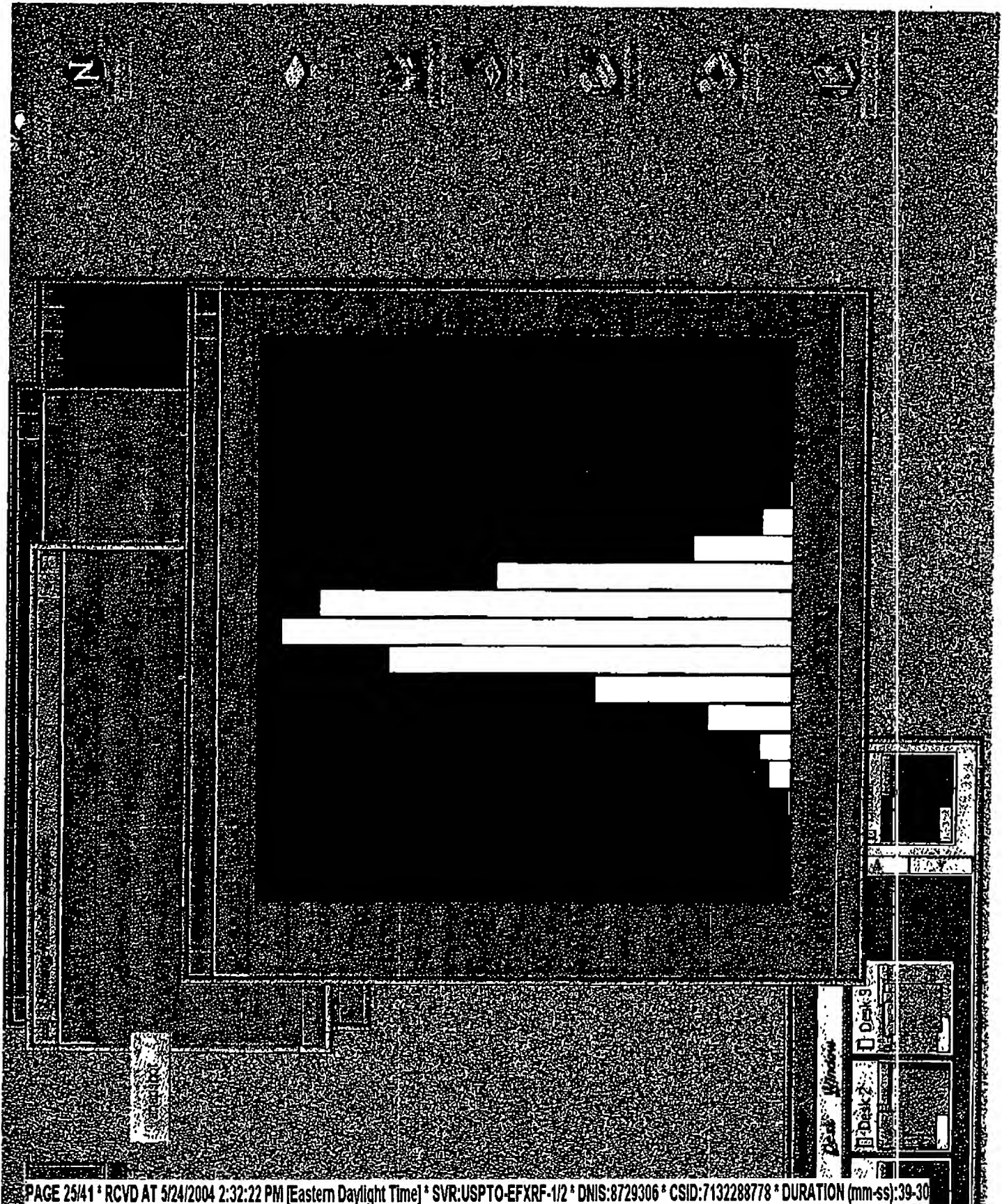


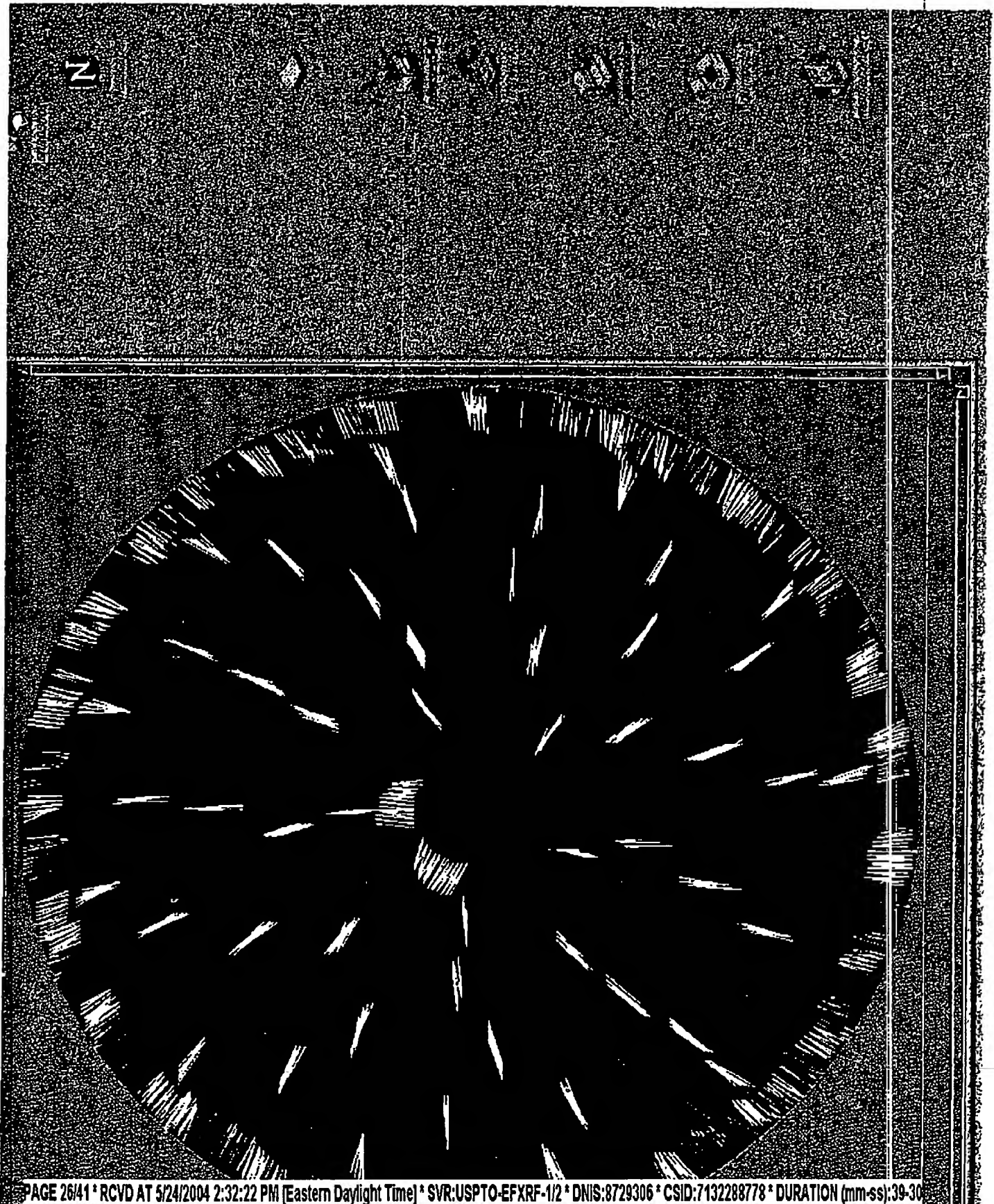


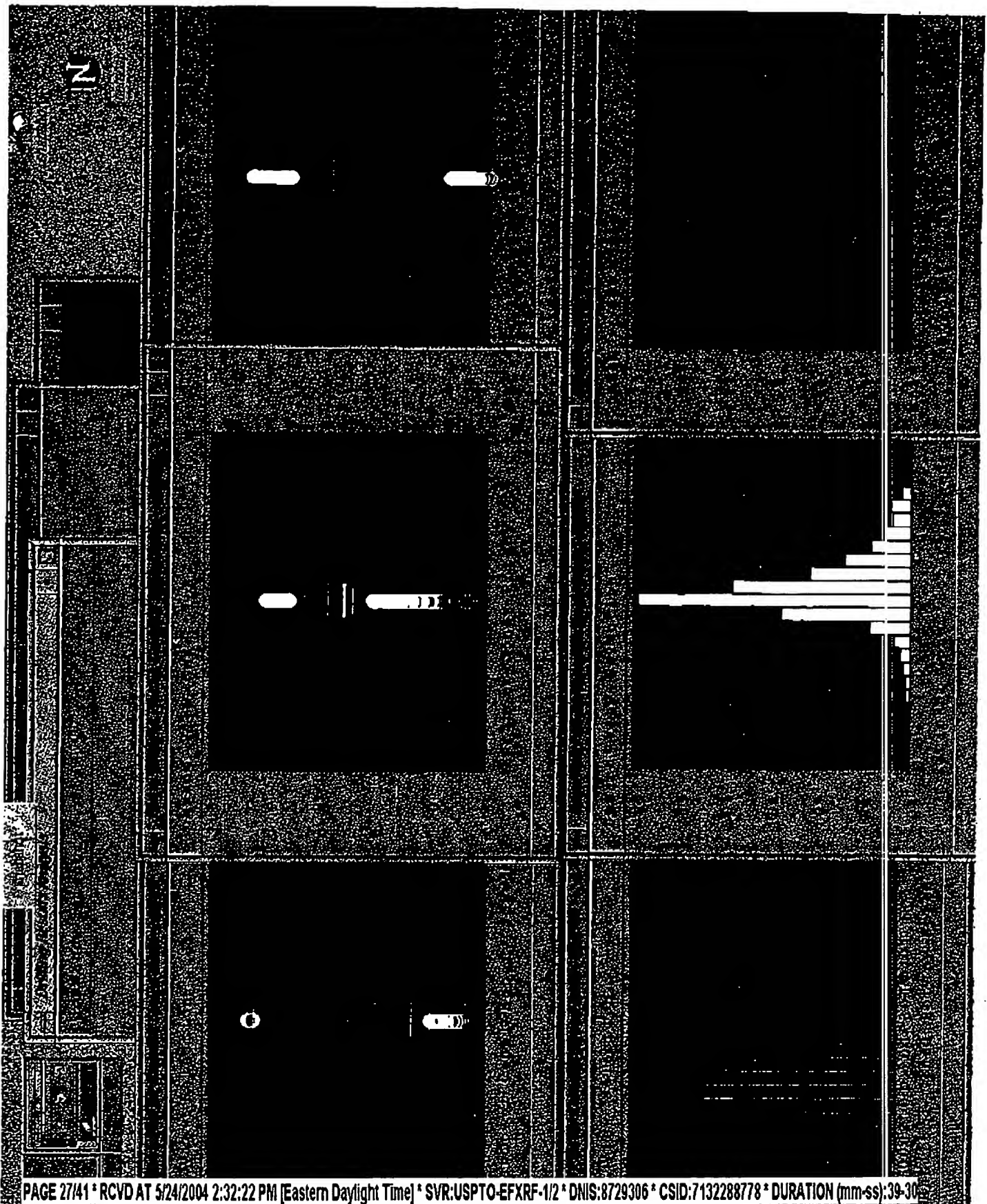


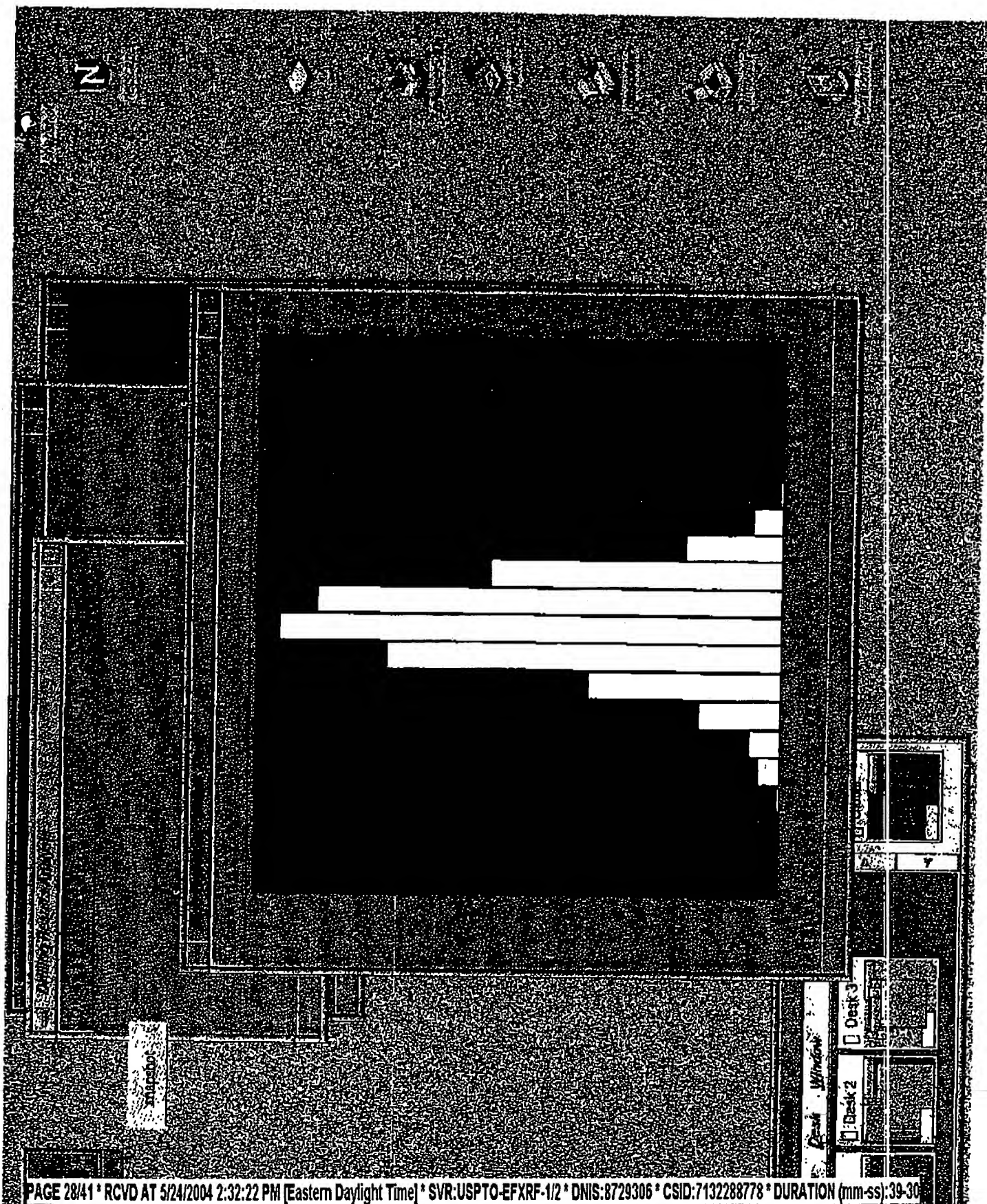












AS Calculation Summary

Subject: /users/ps9978/pr jfl0t(offsetf10r)
 Diameter of Bit: 7.87 (in) [200 (mm)]
 Weight on Bit: 42000 (lbf) [19051 (kgf)]
 Revolutions per minute: 170 (rpm)
 Revolutions of Simulated: 30 (rev)
 Coefficient of Rock-shell contact: 1
 Contact Area: 48.707 (sq.in)

offset

.375

Cut Area Coverage
(sq.in) %

21.29	43.70
16.90	34.69
17.62	36.17
18.42	37.82
18.69	38.38
19.16	39.34
18.78	38.55
20.28	41.63
19.38	39.78
19.55	40.15
19.25	39.52
19.68	40.41
17.85	36.66
19.17	39.36
19.07	39.16
18.16	37.29
18.46	37.91
19.47	39.97
17.41	35.74
19.70	40.44
20.02	41.10
18.61	38.20
17.42	35.77
18.70	38.39
17.05	35.00
19.61	40.25
19.62	40.28
19.37	39.77
19.82	40.68
19.88	40.81

Average of Coverage for Bit: 38.90 %

Average of Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in)	CovI %	CovA %
1	3.852	3.937	0.002	0.07	0.00
2	3.696	3.937	0.177	3.05	0.36
3	3.162	3.937	1.950	11.28	4.00
4	1.684	2.658	2.765	20.82	5.68
5	0.232	0.896	0.186	7.91	0.38
1	3.865	3.937	0.003	0.17	0.01
2	3.716	3.937	0.150	2.83	0.31
3	3.139	3.937	1.841	10.37	3.78
4	2.299	3.277	3.582	20.91	7.35
5	0.429	1.377	0.984	18.31	2.02
1	3.865	3.937	0.002	0.09	0.00
2	3.704	3.937	0.126	2.24	0.26
3	3.154	3.936	2.060	11.83	4.23

Penetration Depth 0.285 (ft) [87 (mm)]
 ve fit ROP 85.48 (ft/h) [26.05 (m/h)]
 rage Penetration Depth 0.253 (ft)
 rage ROP 86.13 (ft/h)

Row	Fz_max	Fz_median	Fz_aver	Counts	Angle
	27.921	9.409	9.789		
1	0.043	0.001	0.002	22	0.00
2	0.507	0.015	0.036	11	0.00
3	13.478	1.738	2.335	11	0.00
4	24.115	6.980	7.451	9	0.00
5	7.583	0.790	1.235	1	0.00
	33.017	15.419	15.681		
1	0.102	0.001	0.003	22	0.00
2	0.606	0.015	0.035	10	0.00
3	12.631	2.089	2.755	10	0.00
4	31.227	9.346	10.067	11	0.00
5	13.728	3.925	4.008	4	0.00
	30.458	15.388	15.383		
1	0.071	0.001	0.003	22	0.00
2	0.542	0.011	0.030	9	0.00
3	13.085	2.813	3.330	9	0.00
4	17.166	5.811	5.826	9	0.00
5	22.570	6.945	7.075	7	0.00
6	1.179	0.294	0.355	1	0.00

Row	Insert Forces	Fx_aver	Fy_aver	Fz_aver
1		0.110	0.004	0.002
2		0.631	0.041	0.025
3		0.728	0.118	1.457
4		0.210	0.074	5.501
5		0.134	0.238	1.238
1		0.104	0.005	0.003
2		0.598	0.037	0.027
3		0.582	0.117	1.837
4		0.183	0.066	6.462
5		0.196	0.047	3.720
1		0.122	0.006	0.003
2		0.585	0.036	0.025
3		0.488	0.119	2.367
4		0.122	0.097	4.923
5		0.189	0.075	5.552
6		0.042	0.161	0.359

io of Cone Rotary Speed to Bit:

Ratio
 1.2201
 1.3316
 1.3274

aping Brittle File Size 1476096 (bytes)
 tical Brittle File Size 13683936 (bytes)
 ll Contacted Tim s 2021 (times)
 tact Percentage of Shell t Rock 56.1389 %

US Calculation Summary

ject: ./.offsetf10t
 eter of Bit: 7.87 (in) [200 (mm)]
 yht on Bit: 42000 (lbf) [19051 (kgf)]
 olutions per minut : 85 (rpm)
 olutions of Simulated: 30 (rev)
 fficient of Rock-shell contact: 1
 hole area: 48.707 (sq.in)

CutArea Coverage

(sq.in) %

21.29 43.70
 16.90 34.69
 17.62 36.17
 18.42 37.82
 18.69 38.38
 19.16 39.34
 18.78 38.55
 20.28 41.63
 19.38 39.78
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 19.07 39.16
 18.16 37.29
 18.46 37.91
 19.47 39.97
 17.41 35.74
 19.70 40.44
 20.02 41.10
 18.61 38.20
 17.42 35.77
 18.70 38.39
 17.05 35.00
 19.61 40.25
 19.62 40.28
 19.37 39.77
 19.82 40.68
 19.88 40.81

range of Coverage for Bit: 38.90 %

range f Coverage for Each Row:

Row	Rmin (in)	Rmax (in)	C.Avr (sq.in) %	CovI %	CovA %
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2	3.704	3.937	0.126	2.24	0.26
3	3.154	3.936	2.060	11.83	4.23
4	2.791	3.707	2.531	13.53	5.20

Penetration Depth 0.285 (ft) [87 (mm)]
 ave fit ROP 42.74 (ft/h) [13.03 (m/h)]
 range Penetration Depth 0.253 (ft)
 range ROP 43.07 (ft/h)

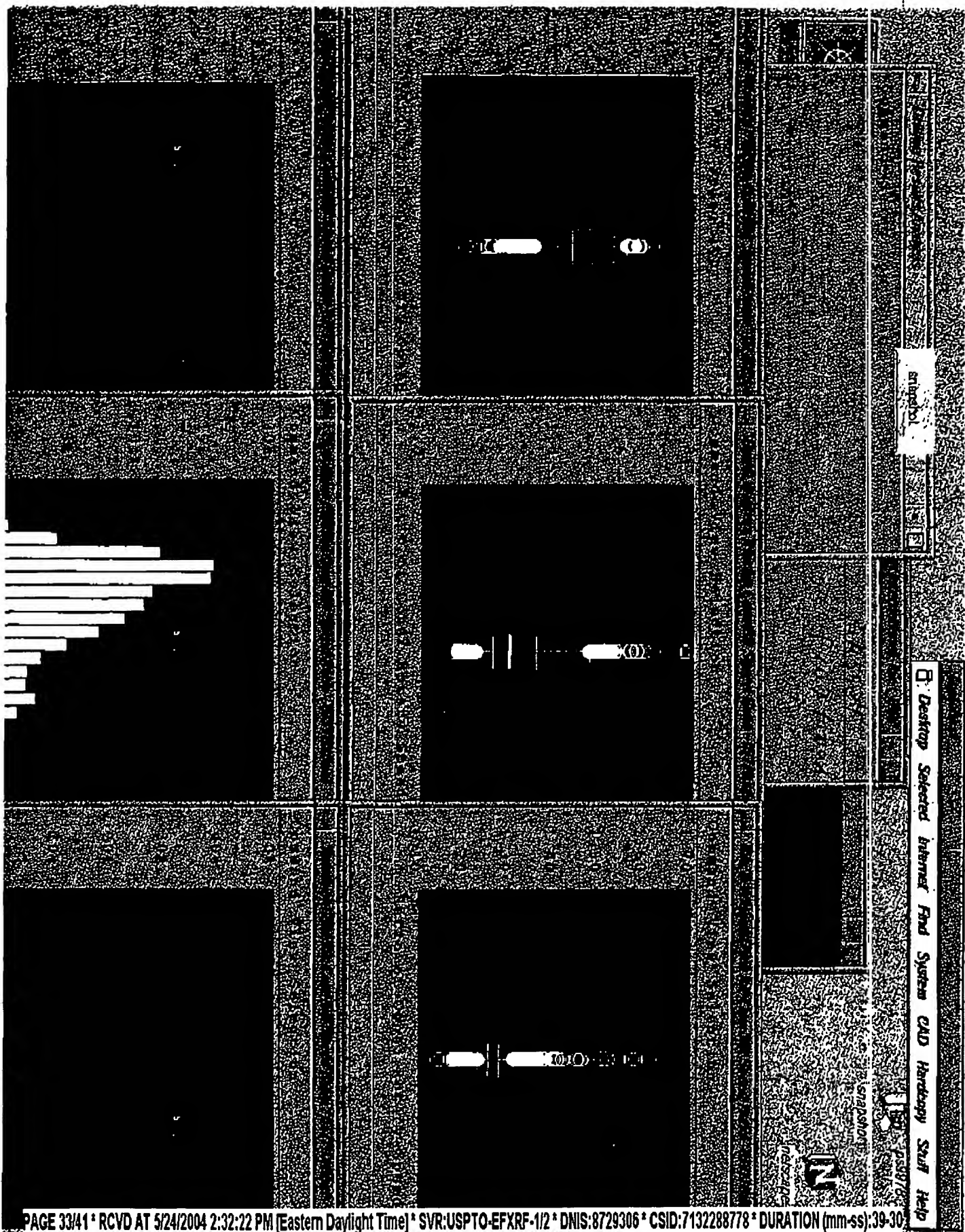
Row	Fz_max	Fz_median	Fz_aver	Counts	Angle
	27.921	9.409	9.789		
1	0.043	0.001	0.002	22	0.00
2	0.507	0.015	0.036	11	0.00
3	13.478	1.738	2.335	11	0.00
4	24.115	6.980	7.451	9	0.00
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	33.017	15.419	15.681		
1	0.102	0.001	0.003	22	0.00
2	0.606	0.015	0.035	10	0.00
3	12.631	2.089	2.755	10	0.00
4	31.227	9.346	10.067	11	0.00
5	13.728	3.925	4.008	4	0.00
	30.458	15.388	15.383		
1	0.071	0.001	0.003	22	0.00
2	0.542	0.011	0.030	9	0.00
3	13.085	2.813	3.330	9	0.00
4	17.166	5.811	5.826	9	0.00
5	22.570	6.945	7.075	7	0.00
6	1.179	0.294	0.355	1	0.00

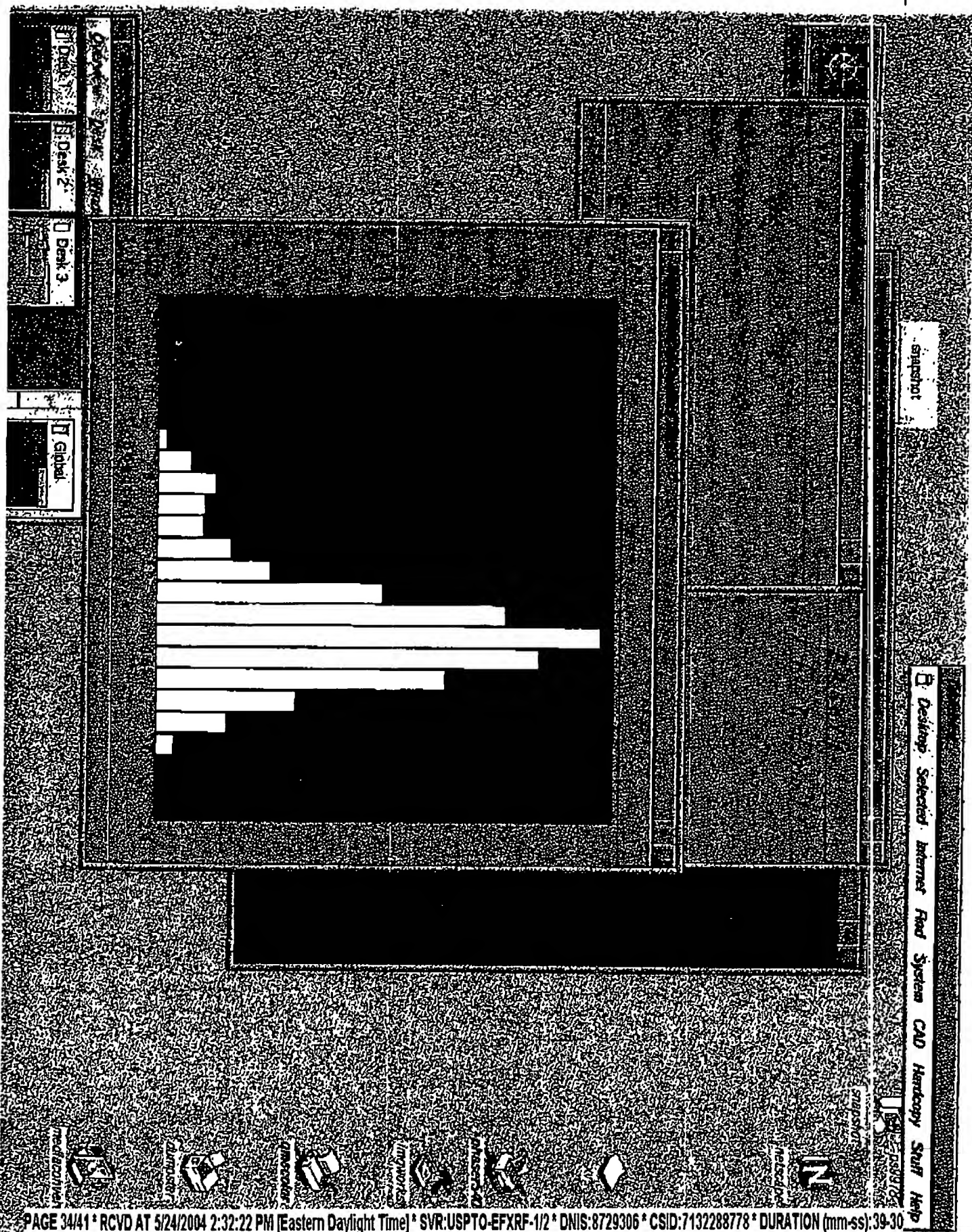
Row	Insert Forces	FX_aver	Fy_aver	Fz_aver
1		0.110	0.004	0.002
2		0.631	0.041	0.025
3		0.728	0.118	1.457
4		0.210	0.074	5.501
5		0.134	0.238	1.238
1		0.104	0.005	0.003
2		0.598	0.037	0.027
3		0.582	0.117	1.837
4		0.183	0.066	6.462
5		0.196	0.047	3.720
1		0.122	0.006	0.003
2		0.585	0.036	0.025
3		0.488	0.119	2.367
4		0.122	0.097	4.923
5		0.189	0.075	5.552
6		0.042	0.161	0.359

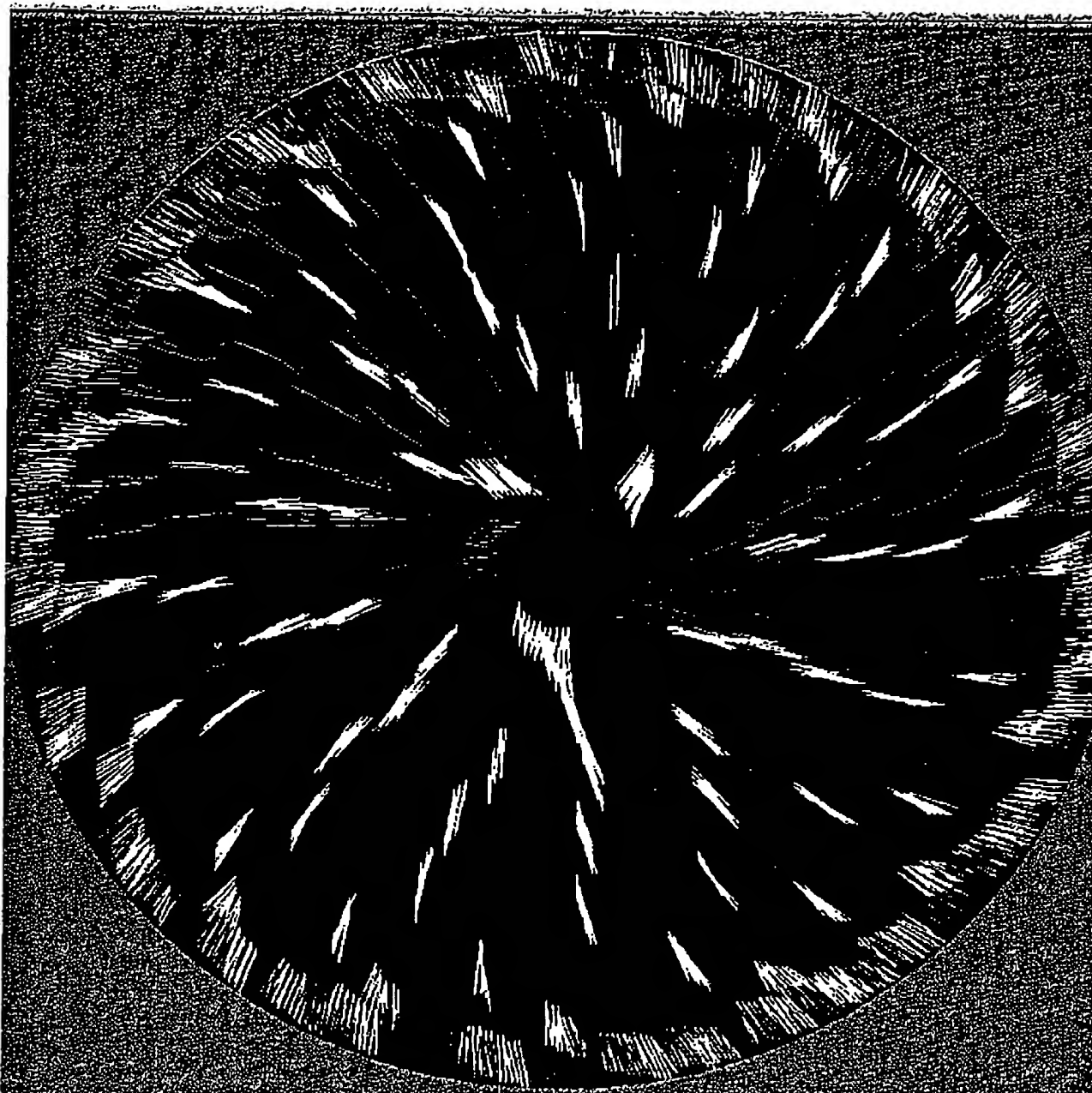
Ratio of Cone Rotary Speed to Bit:

Ratio
 1.2201
 1.3316
 1.3274

Logging Brittle File Size 1476096 (bytes)
 Critical Brittle File Size 13683936 (bytes)
 Well Contacted Times 2021 (times)
 Contact Percentage of Shell to Rock 56.1389 %

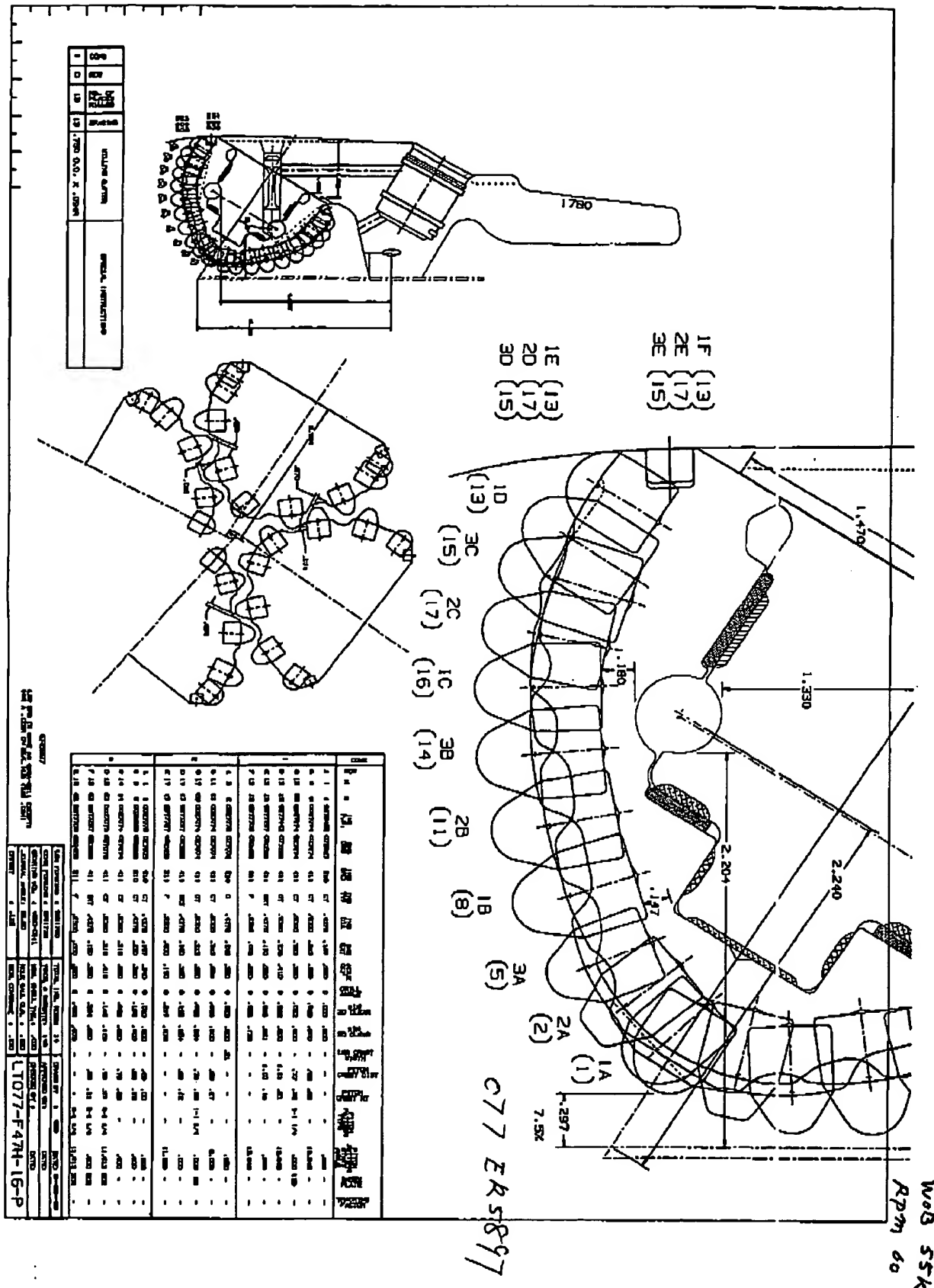


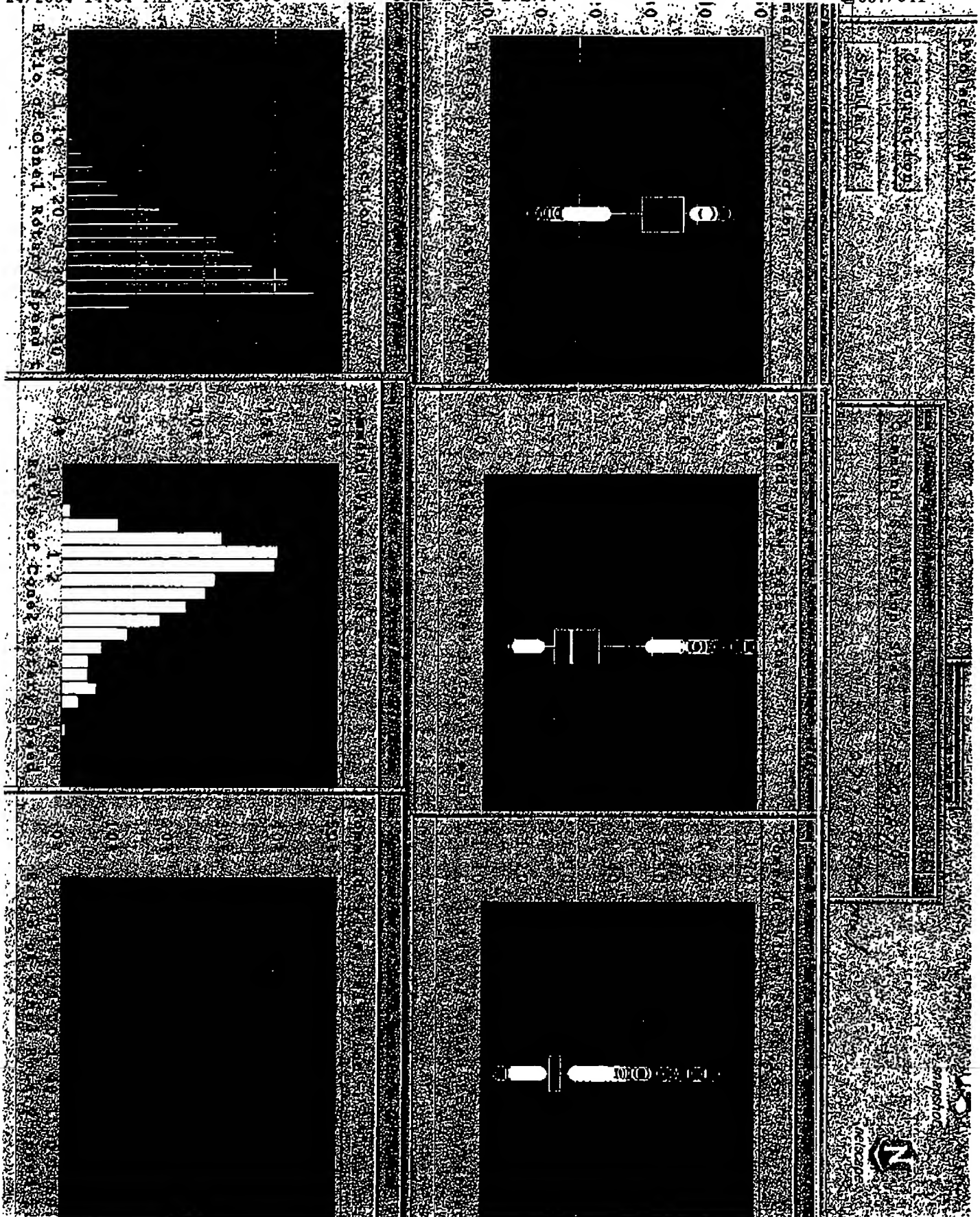


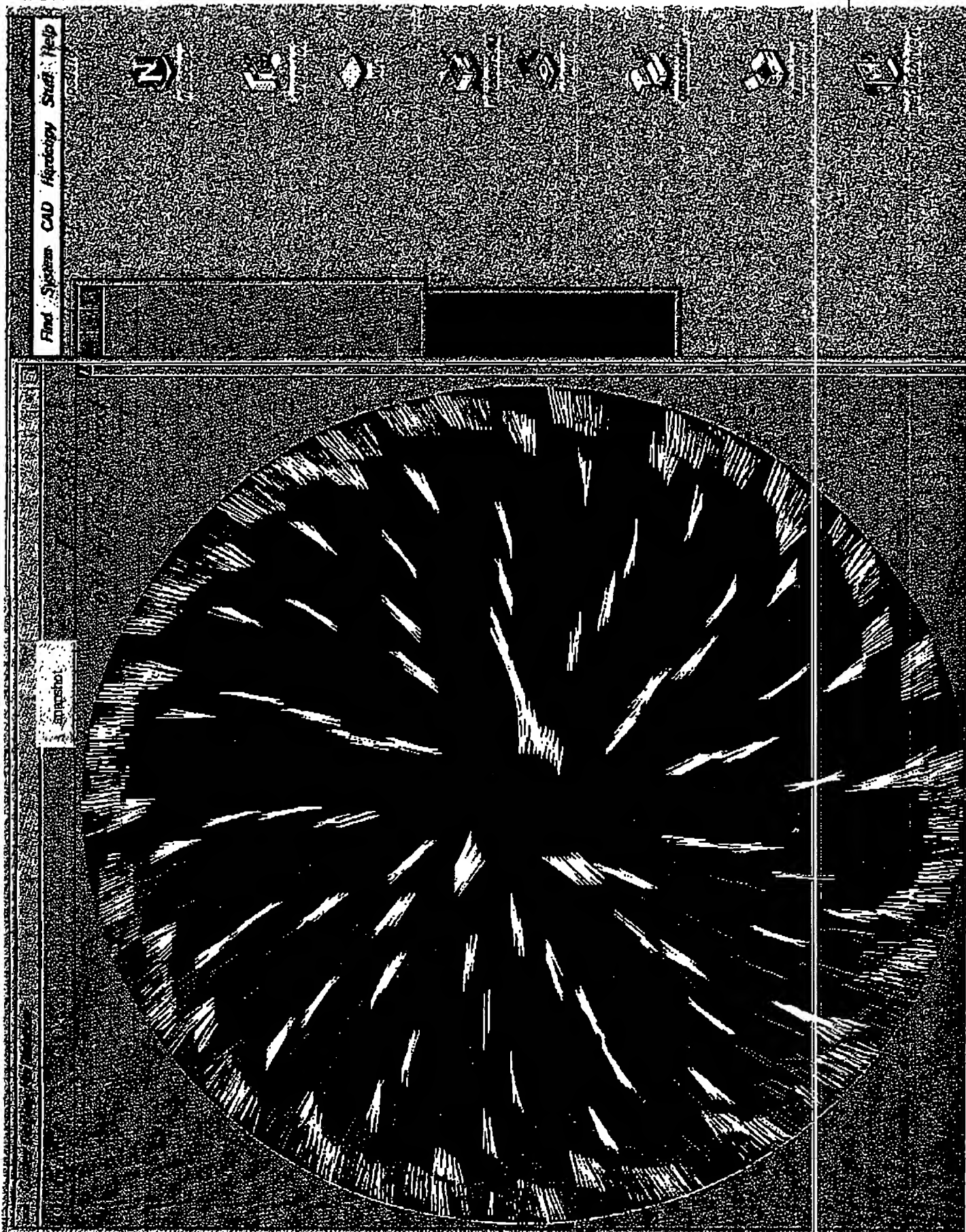


035/041

And System CAD Hierarchy Staff Help







Peer Review

Project Information:

Page: 1

Title: 077f101

Number: cs-p-15

Leader(s): YING XIANG

Meeting Schedule:

Date: Feb. 10, 2000

Time: 9.00 a.m.

Place: room 2002

Meeting Objectives:

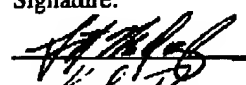
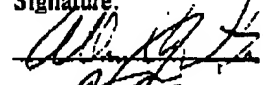
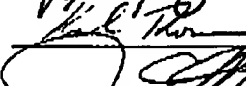
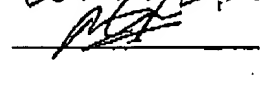
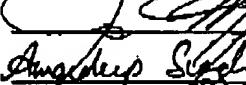
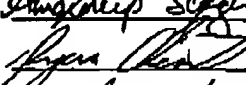
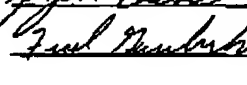

077 F10t cutting structure design review

Agenda Topics

Time Allotment

Review Product Brief	<input checked="" type="checkbox"/> PDP	<input type="checkbox"/> ECR	<input type="checkbox"/> CAR	<input type="checkbox"/> EPA	10
information from the field					10 min
Review new design					45 min
open discuss					15 min
Recap Meeting and Action Items					5 min

Invitees: (Attendance indicated by signature)

Name:	Signature:	Name:	Signature:
SCOTT McDONOUGH		ALLAN WATSON	
Karl Pese		Prabakar Centala	
JIM MINIKUS			
AMAR SINGH			
LYAN CHEEVER			
Red Garbrecht			

Design Review Result:

<input type="checkbox"/> Unconditional Approval (No change required)	<input type="checkbox"/> Conditional Approval (Action items must be completed)	<input type="checkbox"/> Another Design Review Required (Redesign and conduct another design review)
---	---	---

Verification:

Manager/Supervisor Signature: _____ Date: _____

Peer Review

Project Information:**Page: 2**

Title: 077F10t

Number: CS-P-15

Date: Feb. 10, 2000

Action Items:

short the existing bearing sleeve. put bullet seal.
mud bug system on the bit.

Action Taken:

name it f10 in system
ER number for field.

Action Taken:**Action Taken:****Action Taken:****Action Taken:****Action Taken:****Action Taken:****Action Taken:****Action Items Addressed:**

Project Leader's Signature: _____

Date: _____

SMITH TOOL

ENGINEERING ORDER

No.: 24017

Sheet 1 of 1

Location: PONCA

PROJECT/ECR NO.: C9-P-15

E.R. NO.: 5897

SIZE/TYPE: 077 F10T

BEARING NO.: 525-0540

TITLE: IDEALS BIT DESIGN

DESCRIPTION:

CREATED A NEW BOM FOR 077 F10T TYPE BIT

BIT FEATURES:

- 1.) THIS NEW BIT CUTTING STRUCTURE IS DESIGNED TO GAIN HIGHER ROP - BETTER DULL CONDITION BY USING IDEALS SA CUTTING STRUCTURE ANALYSE TOOL.
- 2.) NO TRUE CUT FEATURE - ROW COUNT, INSERT COUNT ARE OPTIMIZED TO ACHIEVE HIGHER ROP.
- 3.) TWO NEW INNER ROW INSERTS - THREE DIFFERENT GAGE ROW INSERTS WITH DIFFERENT DIA. - DIFFERENT LOCATIONS ALONG GAGE CURVE.
- 4.) THIS BIT ALSO FEATURES A NEW BRG WITH BULLET SEAL SIMILAR TO BRG 525-0580.

ISSUED

MAR 08 2000

ENGRG. HOUSTON

PART #	REV.	DRAWING #	REV.	PART # SUPERCEDED	DRAWING # SUPERCEDED	DESCRIPTION
0026557						BOM FOR 077 F10T TYPE BIT NEW
0026848		205380				CONE 1 077 F10T ASSY NEW
0026849		205381				CONE 2 077 F10T ASSY NEW
0026850		205382				CONE 3 077 F10T ASSY NEW
		205376				CONE 1 077 F10T PROF. & DRILL NEW
		205377				CONE 2 077 F10T PROF. & DRILL NEW
		205378				CONE 3 077 F10T PROF. & DRILL NEW
		205388				CONE BRG DETL NEW
0026854		205383				LEG MACH DETL NEW
		205384				JRNL MACH DETL NEW
		205385				JRNL FINISH DETL NEW
		205386				LEG REMILL DETL NEW
		205389				SHALE BURN INSERT DETL NEW
0026855		00026855				AG PLT. SPINODL BRG SLV NEW
0026445		00026445				TCI SRCVSB 1/2 DIA./380GP/320EXT. NEW
0026289		00026389				TCI SRCVSB 9/16 DIA./410GP/430EXT. NEW

EASON: PRODUCT MANAGER'S REQUEST

POSITION OF AFFECTED PARTS: N/A

Prepared By:
LEONARD WRIGHTApproved By:
GARY GARCIADate:
08 MAR 00

Configuration Mgmt.:

Date:

Smith International
Smith Tool

*** PONCA CITY ***
Indented Bill of Material Report

Date: 08-MAR-00
Page: 1

Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF

IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
1	0026848	--	1 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205380	--	DWG 1 CONE 077 F10T ASSEMBLY		
2	D205376	--	DWG 1 CONE 077 F10T PROF & DRILL		
2	0009874	D	SRTC TCI 1/2 FB .203 EXT/.470 GP/GR 411H	1.000	EA
3	D0009874	--	DWG SRTC TCI 1/2 FB.203 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026445	--	SCRVB TCI 1/2 FB .320 EXT/.380 GP/GR 614	9.000	EA
3	D0026445	--	DWG SCRVB TCI 1/2 FB .320 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026289	--	SCRVB TCI 9/16 FB.430 EXT/.410 GP/GR 614H	14.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0022626	--	RGCSS TCI 13/32FB .230 EXT .310 GP/GR 510H	18.000	EA
3	D0022626	--	DWG RGCSS TCI 13/32 FB .230 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	18.000	EA
3	D9977707	--	DWG F TCI 1/4 FB.000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
	0026849	--	2 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205381	--	DWG 2 CONE 077 F10T ASSEMBLY		
2	D205377	--	DWG 2 CONE 077 F10T PROF & DRILL		
2	0000231	-	C TCI 7/16 FB .204 EXT/.410 GP/GR 510H	2.000	EA
3	D092765	-	MAIN ENGR DRAW		
2	0026289	--	SCRVB TCI 9/16 FB.430 EXT/.410 GP/GR 614H	25.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0018265	--	RGCSS TCI 3/8 FB .200 EXT .310 GP/GR411	15.000	EA
3	D0018265	--	DWG RGC TCI 3/8 FB .200 EXT.		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	15.000	EA
3	D9977707	--	DWG F TCI 1/4 FB.000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
	0026850	--	3 CONE 077 F10T ASSEMBLY	1.000	EA
2	D205382	--	DWG 3 CONE 077 F10T ASSEMBLY		
2	D205378	--	DWG 3 CONE 077 F10T PROF & DRILL		
2	9977315	C	SRTC TCI 7/16 FB .190 EXT/.360 GP/GR 411H	1.000	EA

Smith International
Smith Tool*** PONCA CITY ***
Indented Bill of Material ReportDate: 08-MAR-00
Page: 2

Item: 0026557	Size: 077	Type: F10T	Features:
ER: 5879	IADC: 437X	Pin Size: 4 1/2	BRG #: 525 - -0540
Rev: --	EO: 24017	Status: E	Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
3	3-17315	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026445	--	SCRVB TCI 1/2 FB .320 EXT/.380 GP/GR 614	5.000	EA
3	D0026445	--	DWG SCRVB TCI 1/2 FB .320 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0026289	--	SCRVB TCI 9/16 FB .430 EXT/.410 GP/GR 614H	13.000	EA
3	D0026289	--	DWG SCRVB TCI 9/16 FB .430 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	0023857	--	RGCSS TCI 7/16FB .250 EXT .310 GP/GR 510H	18.000	EA
3	D0023857	--	DWG RGCSS TCI 7/16 FB .250 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	9977707	A	F TCI 1/4 FB .000 EXT/.190 GP/GR 311	18.000	EA
3	D9977707	--	DWG F TCI 1/4 FB .000 EXT		
3	3-1	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
3	50-6(S)	-	SPEC TUNGSTEN CARBIDE INSERTS		EA
2	D093412	-	CONE CARB DTL		
2	D205388	--	CONE BRG DTL		
	0026854	--	LEG 077 OSVB/32.5 JRNL/.312 OFFSET/2.360-C	3.000	EA
2	D205383	--	DWG LEG 077 F10T DOMEVENT W/SHALE GROOVE		
2	9991780	A	LEG FORG/OSVB 073-077 FTCT/FMT (4815)	3.000	EA
3	D087651	D	LEG FORG/OSVB		
3	D087656	B	LEG FORGE INSP		
2	9860104	-	HC-1 HARDMETAL	0.309	LB
2	9860427	-	HARDMETAL ROD ST-70M	0.027	LB
2	9976500	B	F TCI 7/16 OD 9/32GP/GR 311/.015 CHAMP	3.000	EA
3	D081257	B	DWG F TCI 7/16 OD		
2	0024824	--	1/4 FLAT SHALE BURN PLUG	3.000	EA
3	D0024824	--	DWG. 1/4 FLAT SHALE BURN PLUG		
2	D099548	B	LEG PAINT OFF		
2	D098790	F	RSVR DETAIL		
2	D089087	A	JET CIRC DETAIL		
2	D203413	--	LEG MILLING DTL		
2	D205385	--	JRNL FINISH DTL		
2	D205384	--	JRNL MACH DTL		
2	D205386	--	LEG REMILL DTL		
2	D205389	--	SHALE BURN INSERT ASSY		
	9977347	B	BHP 7/16 DIA 2.17 LG - .110 LIP	3.000	EA
2	D090795	L	DWG BHP		
	9970531	B	7/16 DIA BALL	42.000	EA
2	D0024795	B	DWG BALL BEARING		
2	50-6(B)	-	SPEC - 50-6(B)		EA
	0026855	--	AG FLT/SPIN.BRG.SLV 1.9935ID X.070 X .540	3.000	EA
2	D0026855	--	DWG SILVER SPINODL BRG SLV (PRO-E)		
	0018415	A	BULLET SEAL 077-084	3.000	EA
2	D200502	A	DWG BULLET SEAL		

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*** PONCA CITY ***
Indented Bill of Material Report

Date: 08-MAR-00
Page: 3

Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
2	D0021740	A	DWG 077-097 DOMEVENT II RSVR ASSY (PRO-E)		
2	0021735	A	077-097 CANNISTER: DMVT II	3.000	EA
3	D0021735	A	DWG 077-097 CANNISTER: DMVT II (PRO-E)		
2	0021710	--	077-097 DMVT II RSVR BOOT ASSEMBLY	3.000	EA
3	D0021710	--	DWG 077-097 DMVTII RSVR BOOT ASSY W/9RIBS		
3	0021909	--	077-097 BOOT RUBBER: (PRO-E)		EA
3	0021711	--	077-097 DMVT II BOOT REINFORCING SLEEVE		EA
4	D0021711	--	DWG 077-097 DMVT II BOOT R.F. SLV (PRO-E)		
3	0021712	B	077-097 DMVT II BOOT DISC		EA
4	D0021712	B	DWG 077-097 DMVT II STEEL BOOT DISC (PRO-E)		
4	50-6(N)	-	SPEC - 50-6(N)		EA
2	0021736	--	077-097 RSVR END CAP: DMVT II	3.000	EA
3	D0021736	--	DWG 077-097 RSVR END CAP: DMVT II (PRO-E)		
2	0021713	A	077-097 BELLEVILLE SPRING: DMVT II	3.000	EA
3	D0021713	A	DWG 077-097 (STAINLESS)B-SPRING: (PRO-E)		
3	50-6(L)	-	SPEC - 50-6(L)		EA
2	0021737	--	077-097 DMVT II RETAINING RING	3.000	EA
3	D0021737	--	DWG 077-097 RETAINING RING (PRO-E)		
2	0017620	A	PIPE PLUGS (FLUSH TOP) 1/8-27 - 7/8 TAPER	3.000	EA
3	D200049	A	DWG PIPE PLUG (FLUSH TOP) (PRO-E)		
2	0016327	-	077-097 CANNISTER O-RINGS MAT'L NBR-R	6.000	EA
3	D093799	A	DWG O-RING STATIC		
	9970669	C	O-RING STATIC AS 568-218 / 95 SERIES	3.000	EA
2	D093799	A	DWG O-RING STATIC		
	9930677	A	BOX ASSY (C) 7 5/8 - 7 7/8 3-CONE BITS	1.000	EA
2	9930659	A	BIT BOX C.CC 075 - 077 ALL TYPES	1.000	EA
3	D090378	L	DWG BIT BOX PRINTING & INSIDE DIMENSIONS		
2	9930660	-	BOX LINER (CC) 7 5/8 - 7 7/8 ALL TYPES	1.000	EA
3	D090379	H	DWG BIT BOX LINER		
2	0004897	-	BOX STABILZR (C) 7 5/8 - 7 7/8 ALL TYPES	1.000	EA
3	D095287	E	DWG BIT BOX STABILIZER		
2	9930043	-	BOX TOP (C) 7 5/8 - 7 7/8	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	9930044	-	BOX BOTTOM (C) 7 5/8 - 7 7/8 (PLYWOOD)	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	9930663	A	BOX BOTTOM (C) 7 5/8 - 7 7/8 (FIBRBOARD)	1.000	EA
3	D090380	J	DWG BIT BOX TOPS & BOTTOMS		
2	0018573	--	BIT BOX LABEL (LARGE)	1.000	EA
3	D200136	A	DWG BIT BOX LABEL (LARGE)		
3	0017781	-	BIT BOX LABEL (LARGE)	1.000	EA
3	0017782	-	BIT BOX LABEL (LARGE)	1.000	EA
	9860483	-	BIT GREASE STL-057	1.000	LB
2	9860484	-	GREASE-BRG & O-RING-TEXCLAD #2	0.500	LB
2	9860485	-	PIN PROT COATG-TEXACO COMPND "L" RUST PREV	0.125	LB
2	9860486	-	WELD FILLER-SEAMS & CROWN-AWS E70S-6	1.000	LB
2	9860487	-	WELD FILLER-BALL HOLE PLUG-AWS E70S-6	0.125	LB
	0000091	-	VEE SHIM/OSVB 073 - 077 BITS	1.000	EA
2	D039769	B	DWG VEE SHIM/OSVB		

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*** PONCA CITY ***
Indented Bill of Material Report

Date: 08-MAR-00
Pag : 4

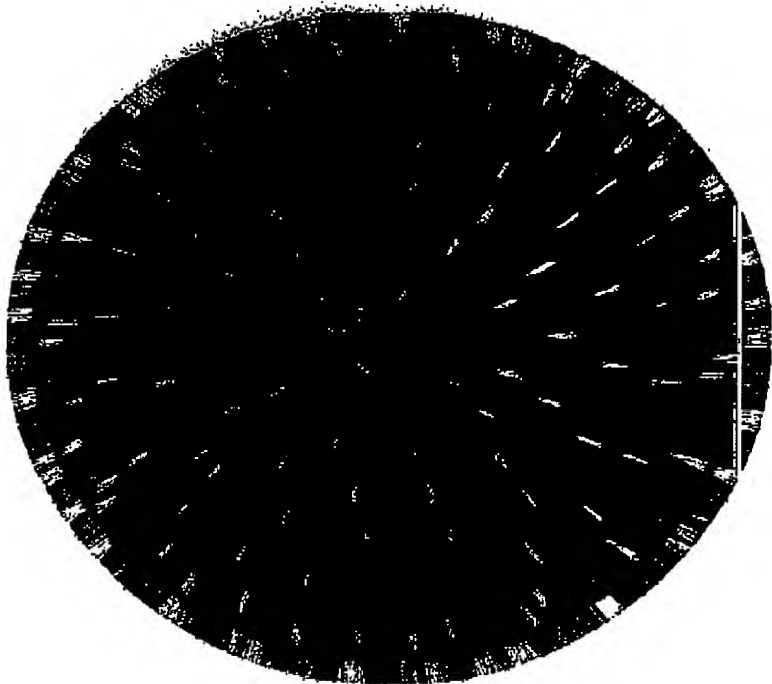
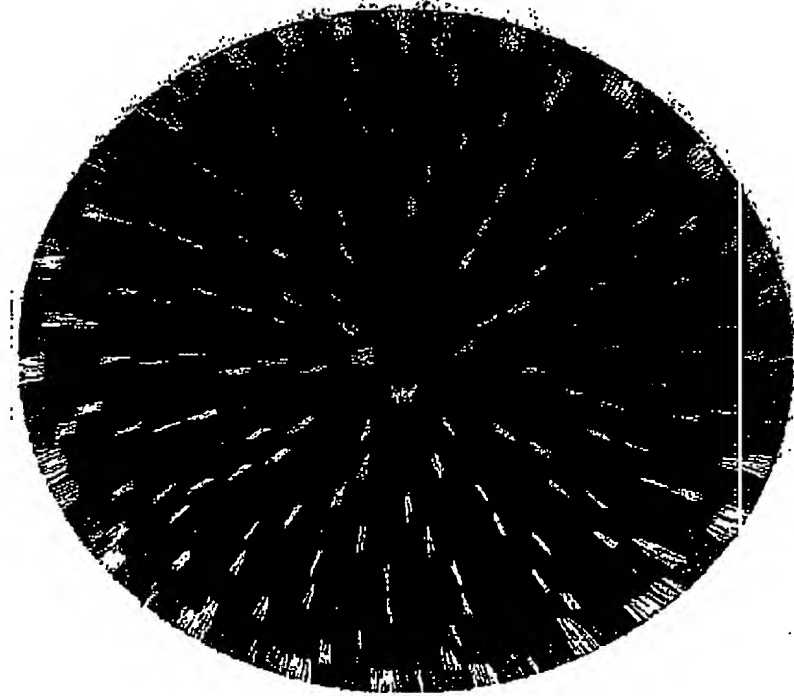
Item: 0026557 Size: 077 Type: F10T Features:
ER: 5879 IADC: 437X Pin Size: 4 1/2 BRG #: 525 - -0540
Rev: -- EO: 24017 Status: E Rev Date: 06-MAR-00

Item Description: 077 F10T ER5879 2312 FPD/AG BRG/SF IADC 437X

LEVEL	COMPONENT	REV	DESCRIPTION	QUANTITY	UOM
2	D044887	B	DWG SIDE SHIM/OSVB		
	9974315	A	DOME SHIM/OSVB 7 5/8 - 7 7/8 BITS	1.000	EA
2	D046369	A	DWG DOME SHIM/OSVB		
	0009960	-	BIT BOX LABEL #2 - "SCULPTURED" INSERTS	1.000	EA
2	D095644	-	DWG BOX LABEL #2 - "SCULPTURED" INSERTS		
	0014200	E	THRUST WASHER 1.059ID X 1.820ODX .070 SLV	3.000	EA
2	D098470	E	DWG THRUST WASHER (SILVER PLATED)		
	9860482	-	BIT PAINT-METALLIC GREEN LACQUER	0.250	LB
	D095459	A	SEAL SEL CHART		
	D205379	--	DWG LAYOUT LT077-F10T-04		

*** End of Report - INDENTED Bill of Material Report ***

IDEAS™ Bit Design: 7 7/8 ER5897 (F47H)



077 ER5897

STD 077 F47H

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STD 077 114711

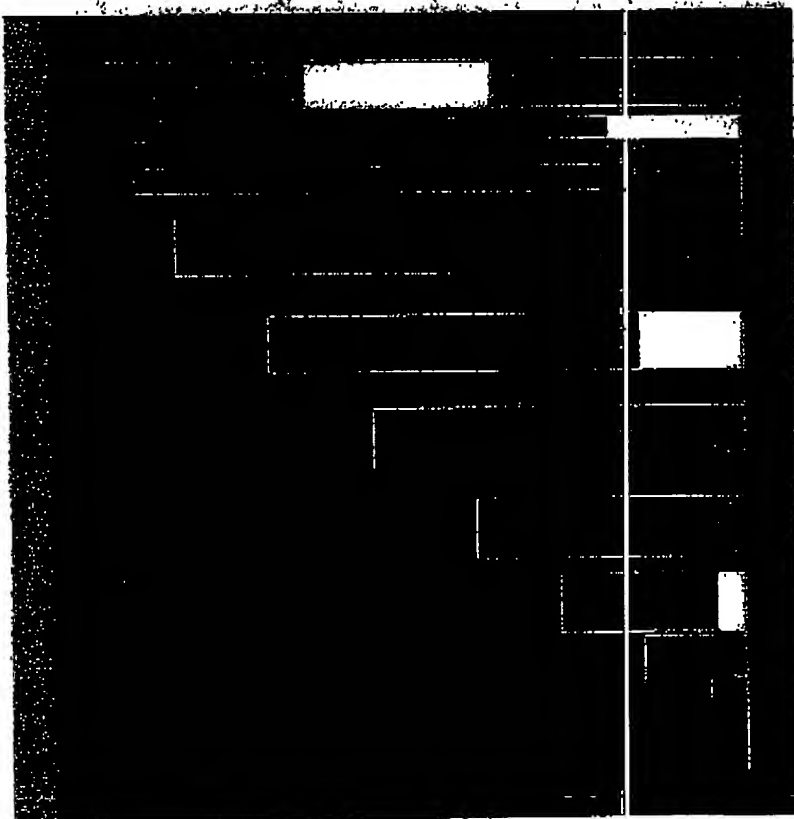
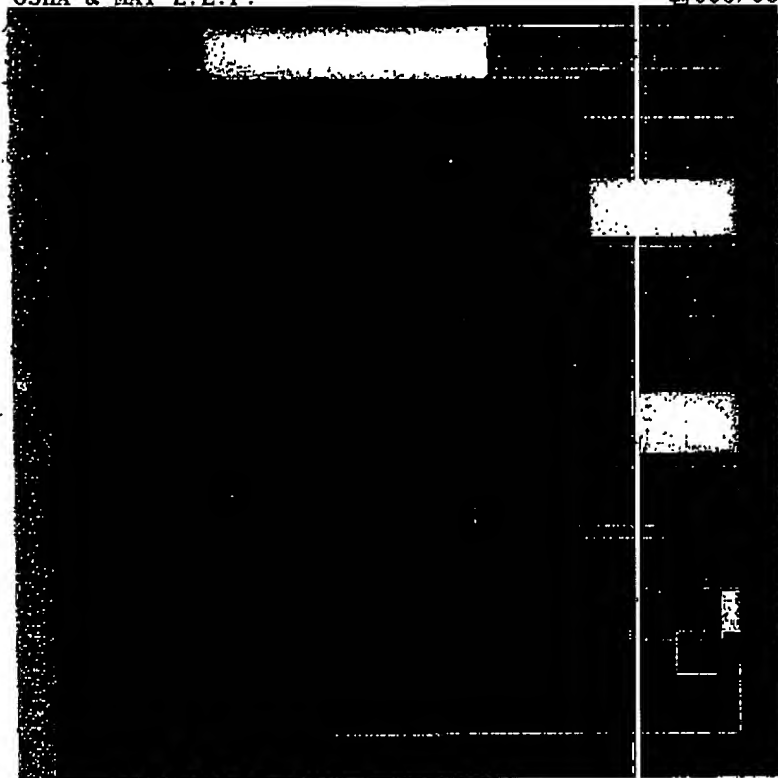
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IDEAS™ Bit Design: 7 7/8 ER 3897 (F47H)

077 ER5897

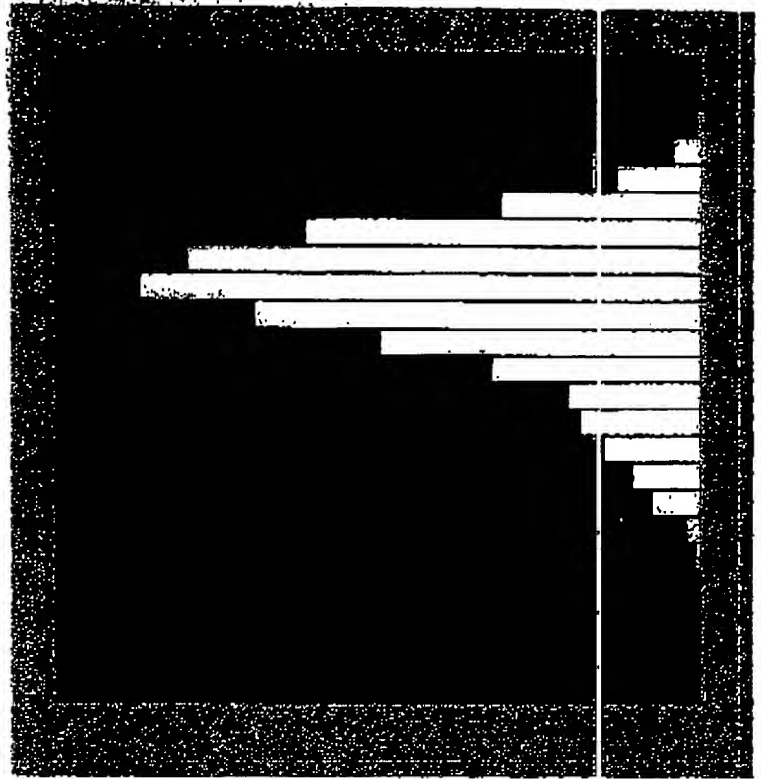
STD 077 F47H



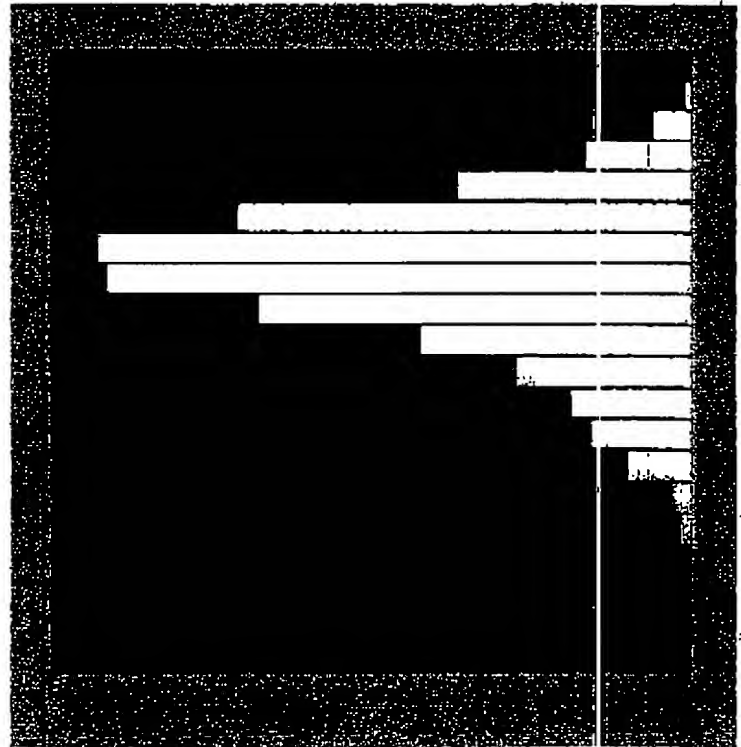
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IDEAS™ Bit Design: 7 7/8 ER5897 (147H)

077ER5897



STD 077 F47H



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